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(12) **United States Patent**
Chong

(10) **Patent No.: US 9,670,696 B2**
(45) **Date of Patent: Jun. 6, 2017**

(54) **ELECTRONIC DEADBOLT**

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(73) Assignee: **Spectrum Brands, Inc.**, Middleton, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 25 days.

(21) Appl. No.: **14/189,782**

(22) Filed: **Feb. 25, 2014**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/776,474, filed on Mar. 11, 2013.

(51) **Int. Cl.**

E05B 47/00	(2006.01)
G07C 9/00	(2006.01)
E05B 47/02	(2006.01)

(52) **U.S. Cl.**

CPC ***E05B 47/0012*** (2013.01); ***E05B 47/026*** (2013.01); ***G07C 9/00174*** (2013.01);
(Continued)

(58) **Field of Classification Search**

CPC G07C 9/0069; G07C 9/00817; G07C 9/00857; G07C 9/00904; G07C 9/00571; G07C 9/00896; E05B 47/00; E05B 47/0001; E05B 63/0056; E05B 2047/0086; E05B 17/042; Y10T 70/7107

USPC 340/5.21, 5.2, 5.7, 5.61, 5.8, 5.22, 5.24, 340/5.25, 5.65; 70/277, 278.2, 278.3; 235/382

See application file for complete search history.

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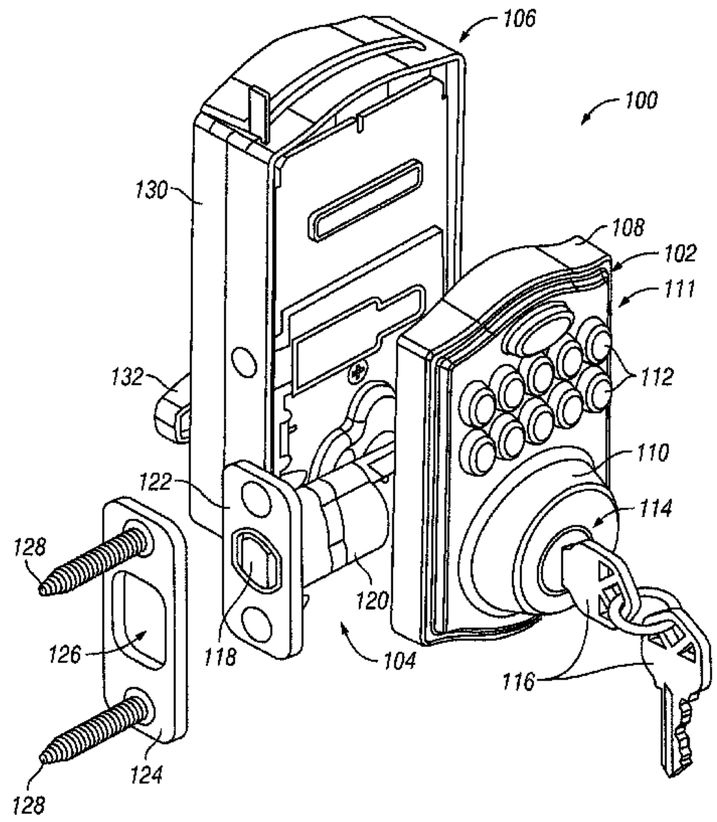
Primary Examiner — Mirza Alam

(74) *Attorney, Agent, or Firm* — Barnes & Thornburg LLP

(57) **ABSTRACT**

An electronic deadbolt assembly with a latch assembly having a bolt movable between an extended position and a retracted position. The deadbolt has an exterior assembly and an interior assembly. The exterior assembly has an electronic input device for entering a passcode and a wiring harness in electrical communication with the electronic input device. The interior assembly includes an electronic control assembly configured to move the bolt between the extended position and the retracted position responsive to an authorized passcode being entered in the electronic input device. The interior assembly has an electrical connector in electrical communication with the electronic control assembly that is configured to be connected with the connector on the exterior assembly.

15 Claims, 22 Drawing Sheets



(52) **U.S. Cl.**
CPC ***G07C 9/00944*** (2013.01); *E05B 2047/002* (2013.01); *E05B 2047/0091* (2013.01); *G07C 9/0069* (2013.01); *G07C 9/00817* (2013.01); *Y10T 70/70* (2015.04); *Y10T 70/7068* (2015.04)

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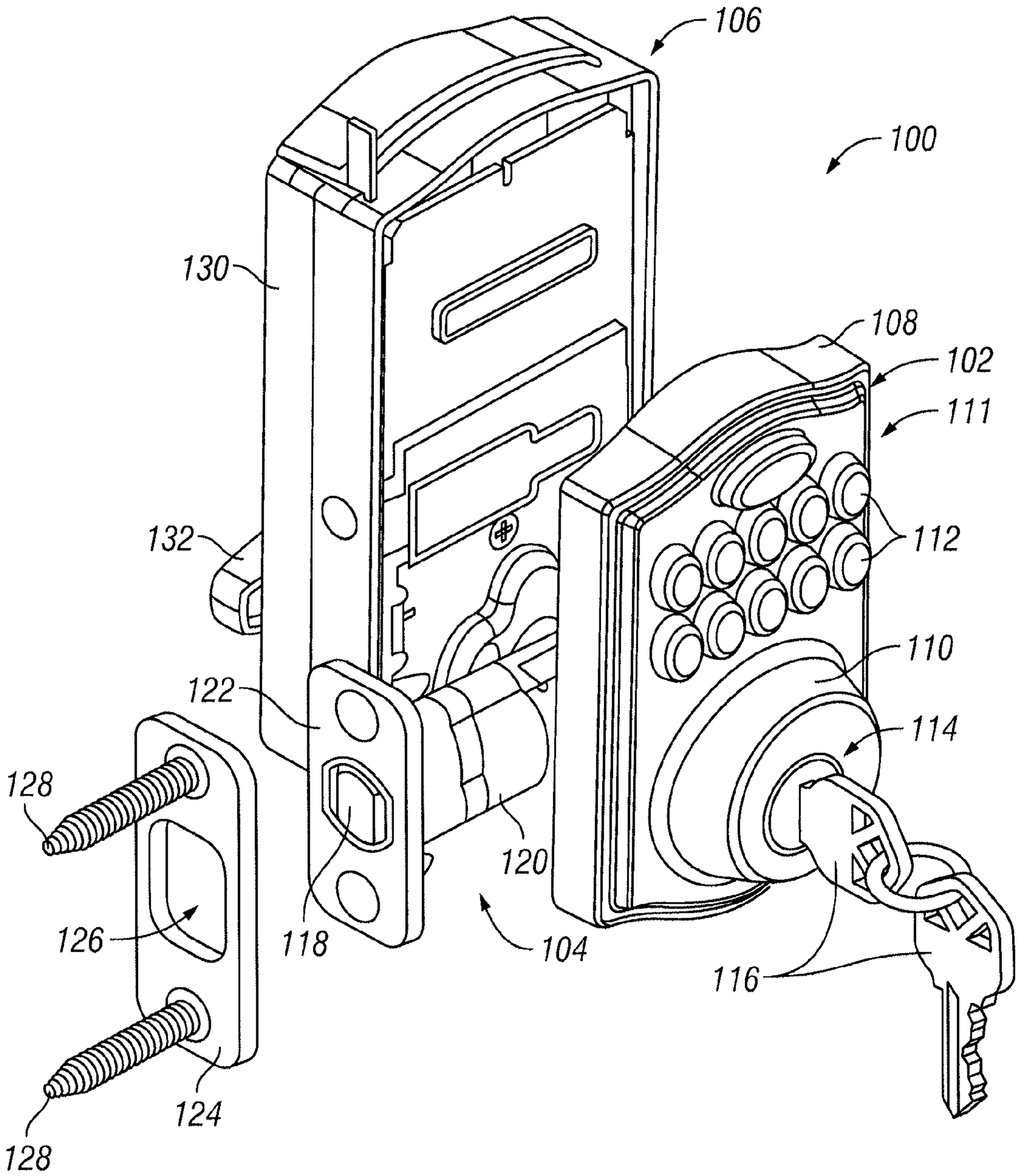
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FIG. 1

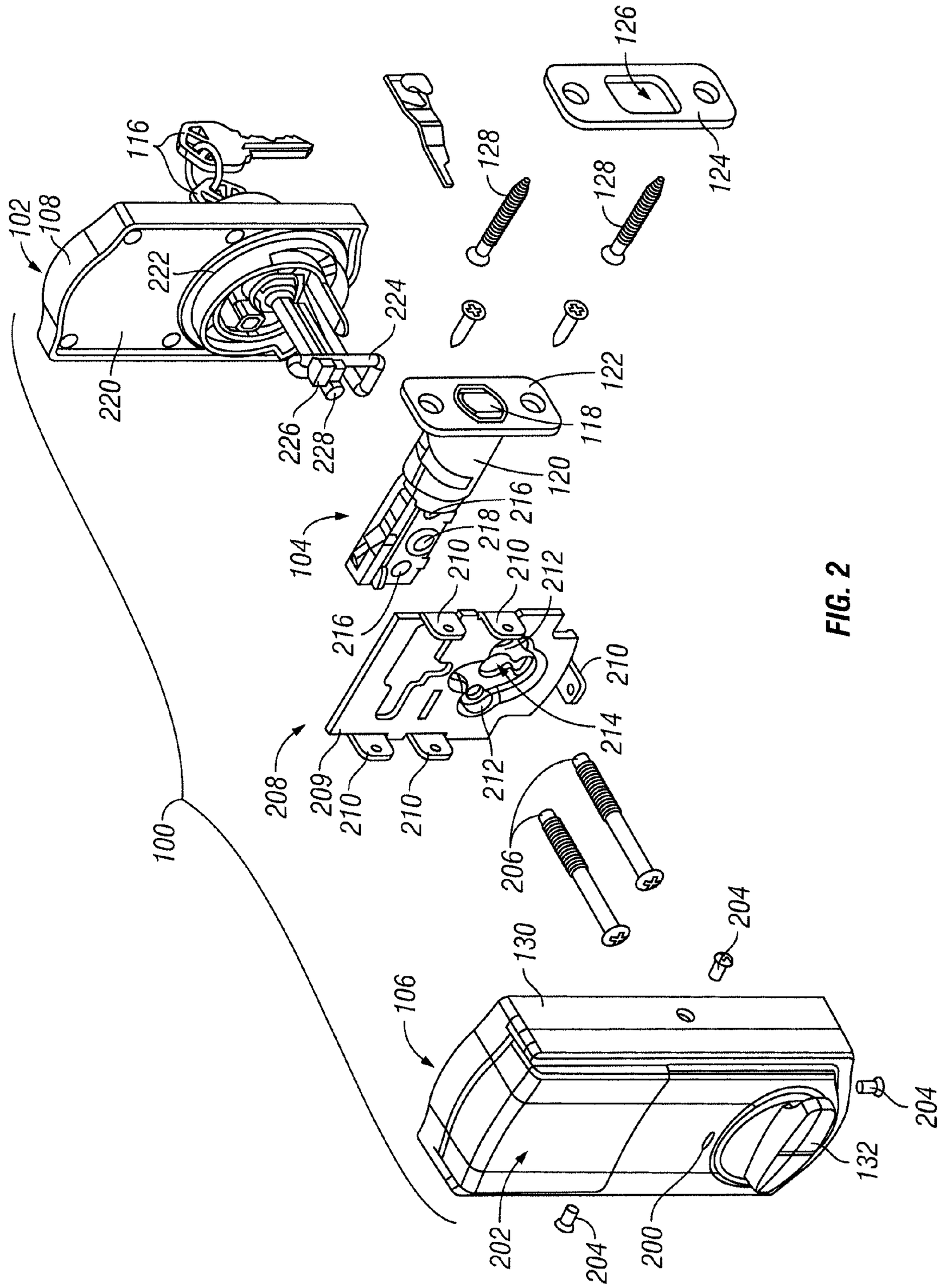
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FIG. 2

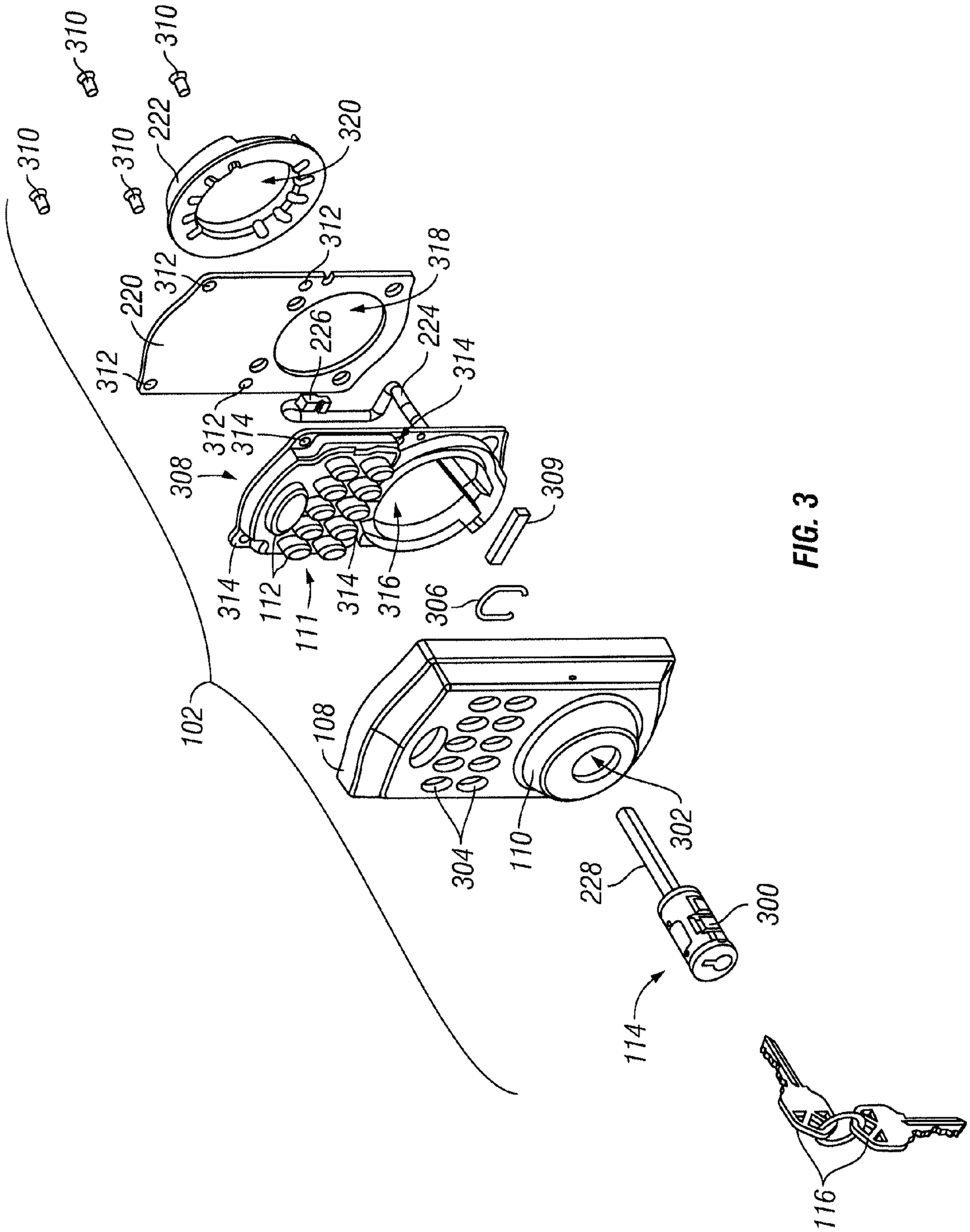
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FIG. 3

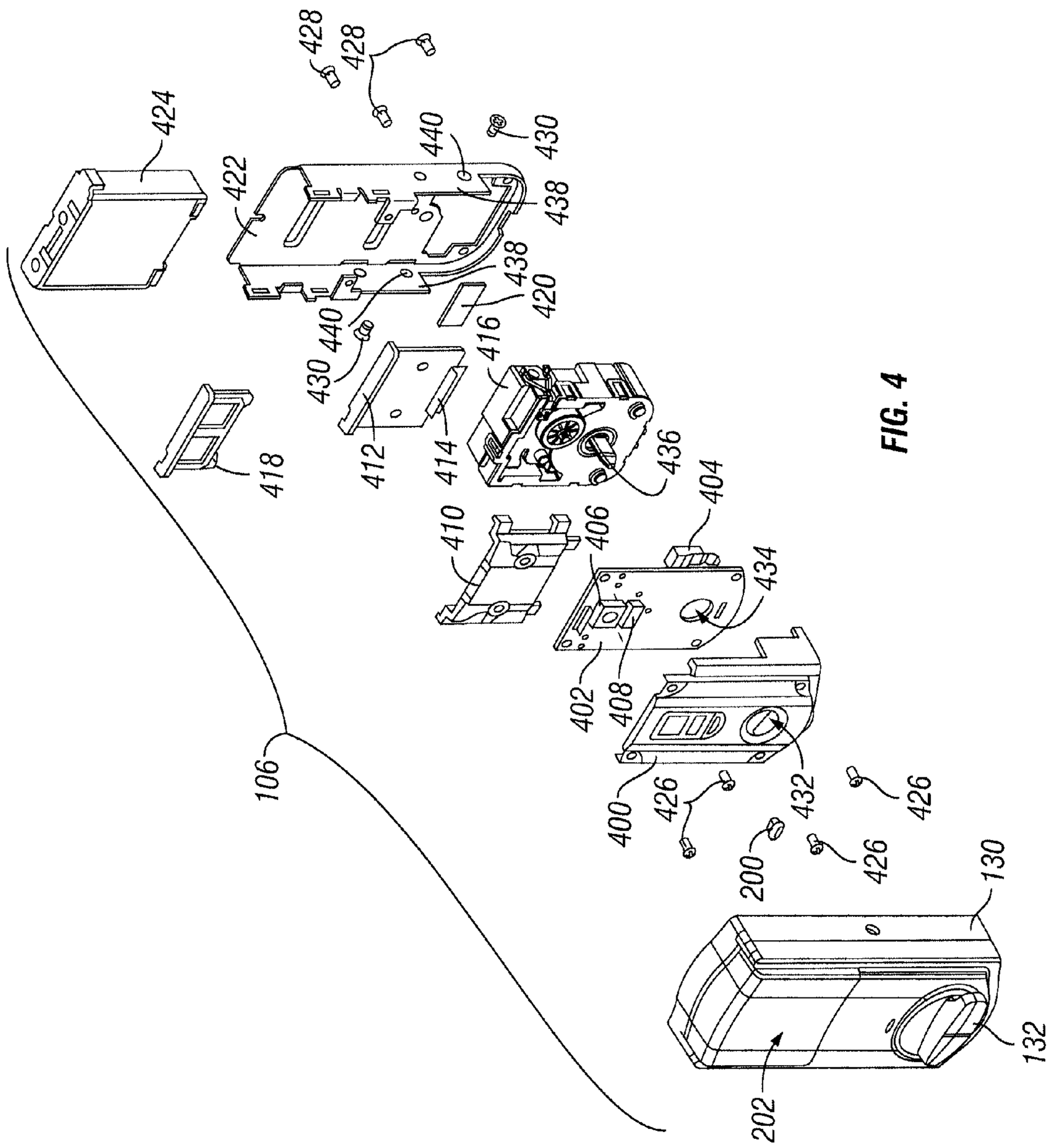
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FIG. 4

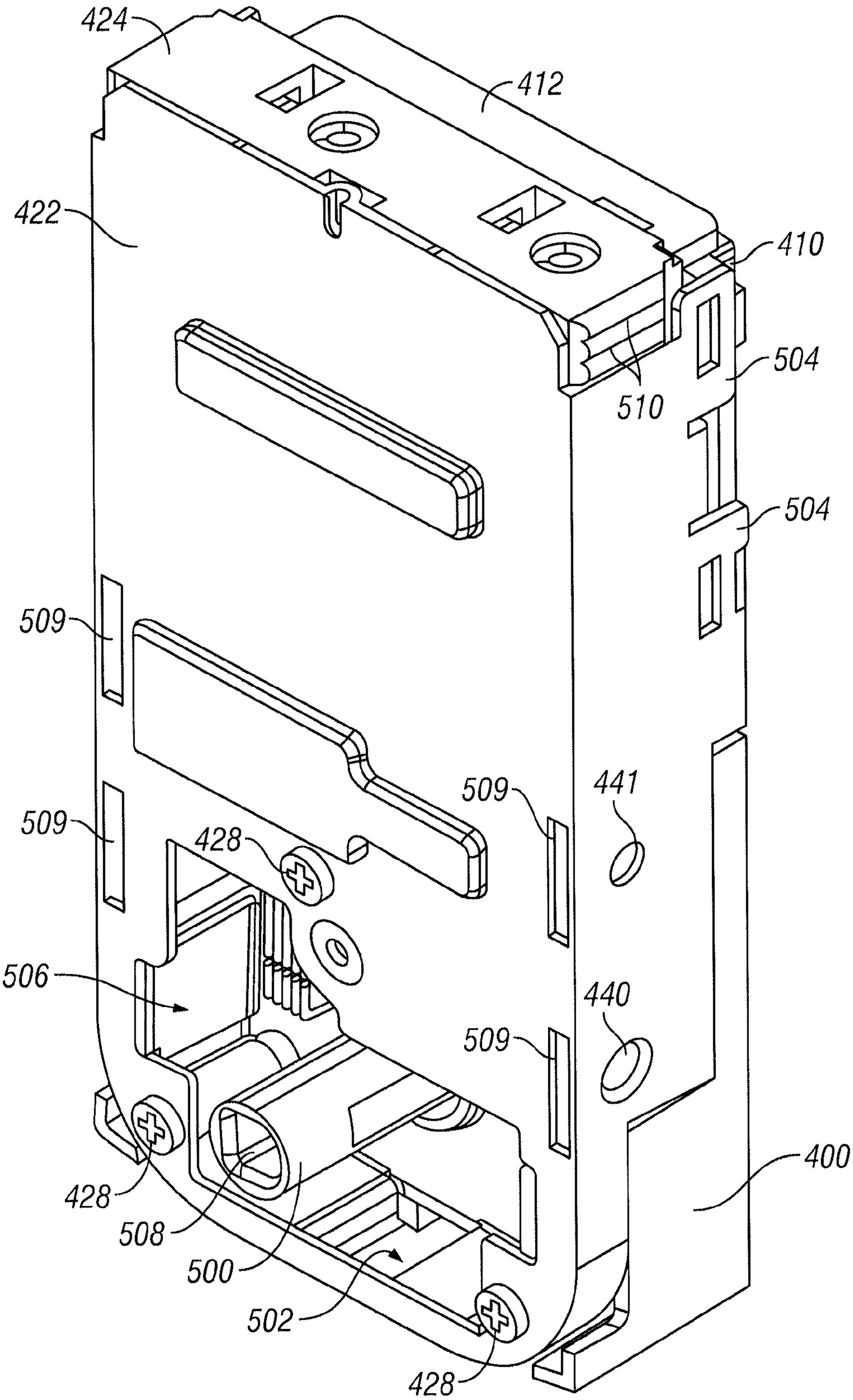
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FIG. 5

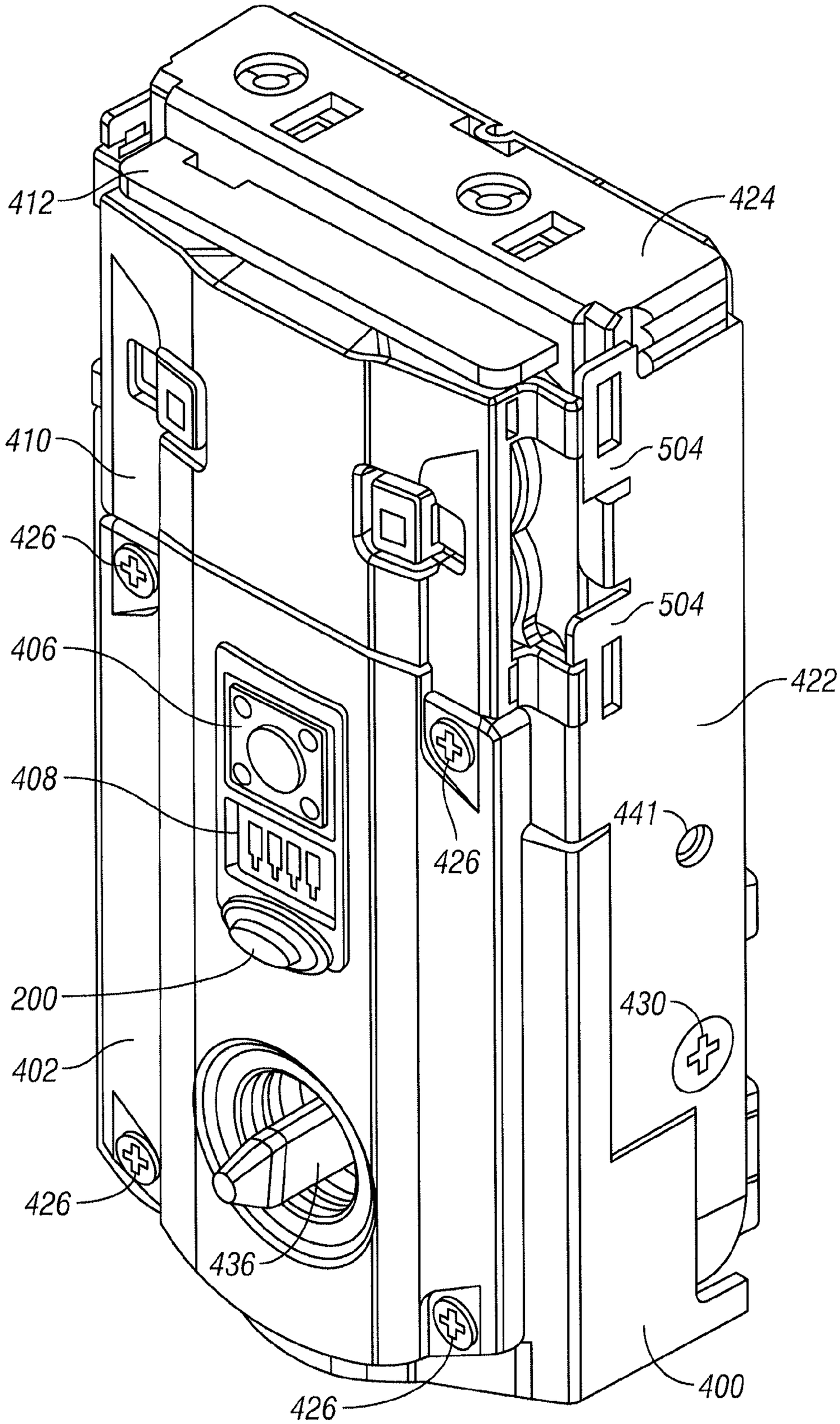
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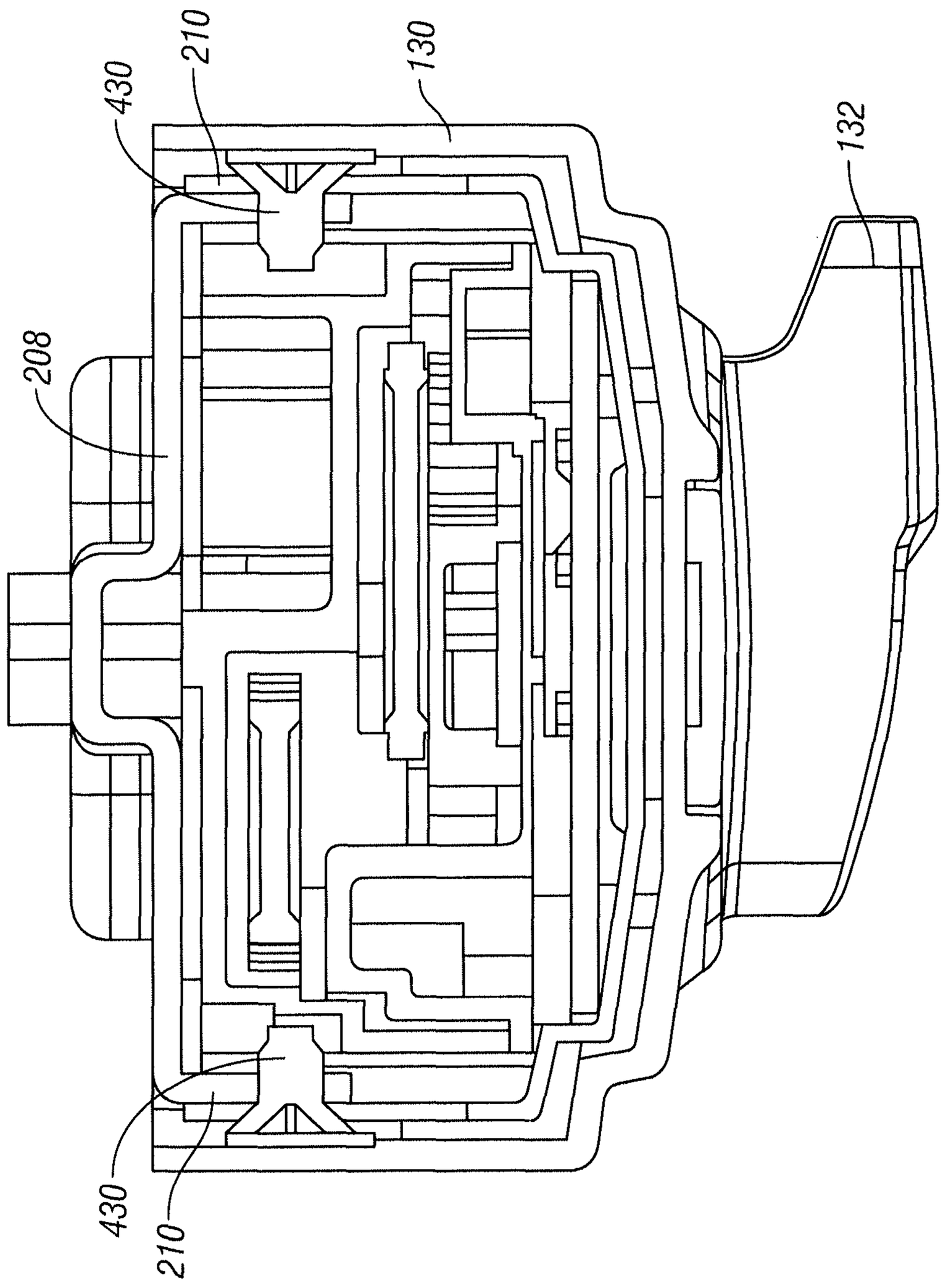
FIG. 6



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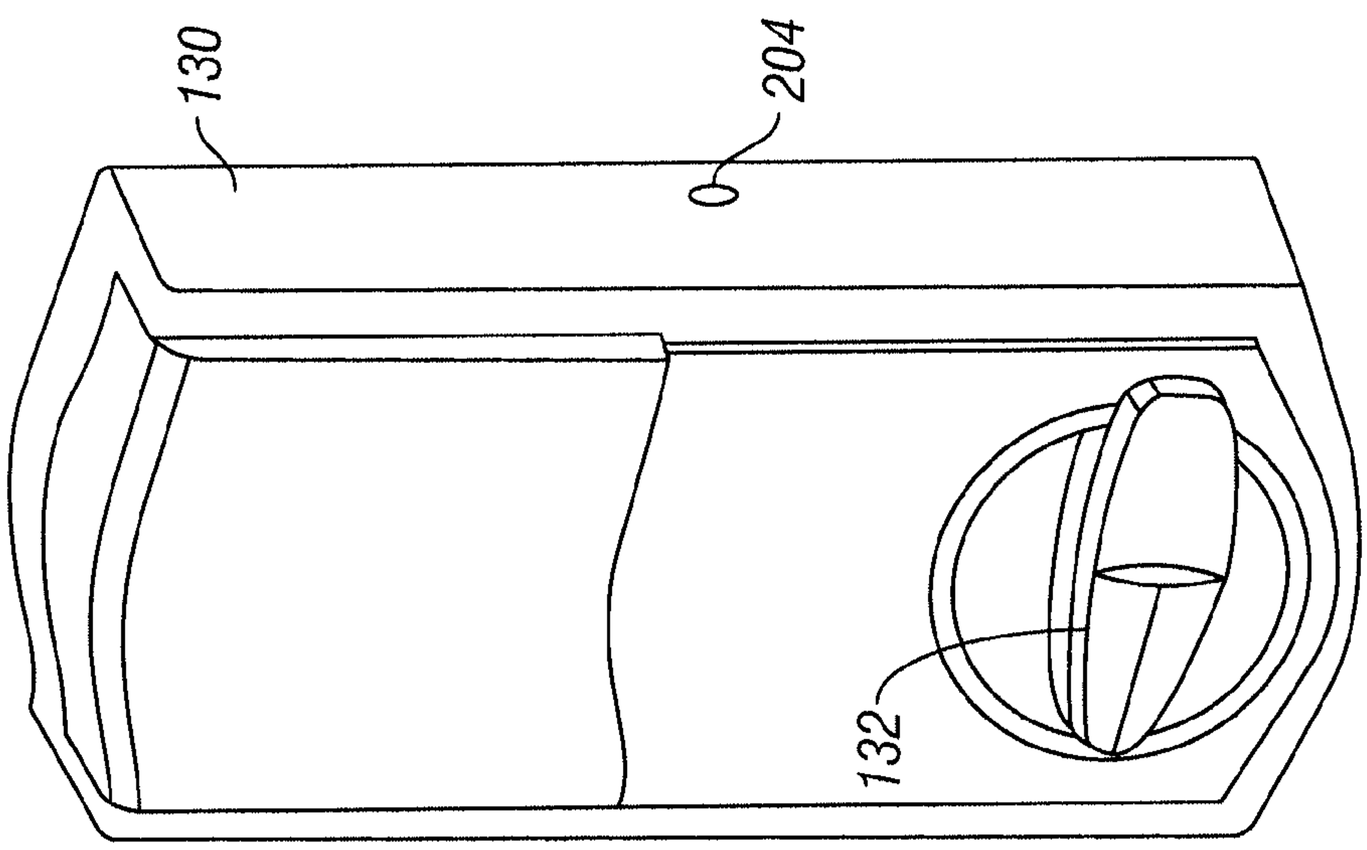

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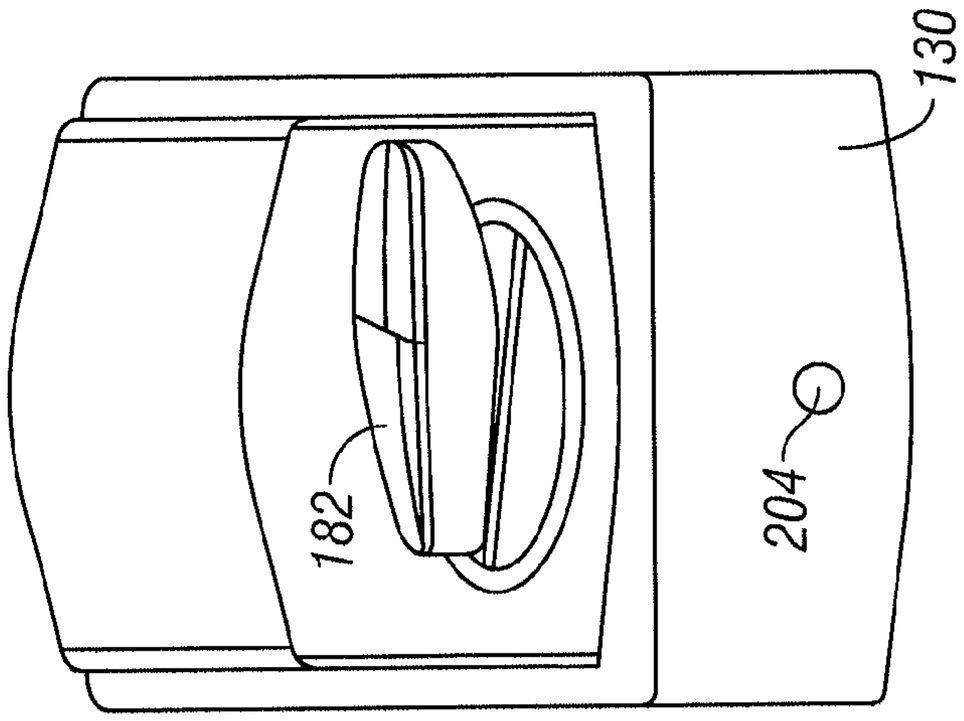

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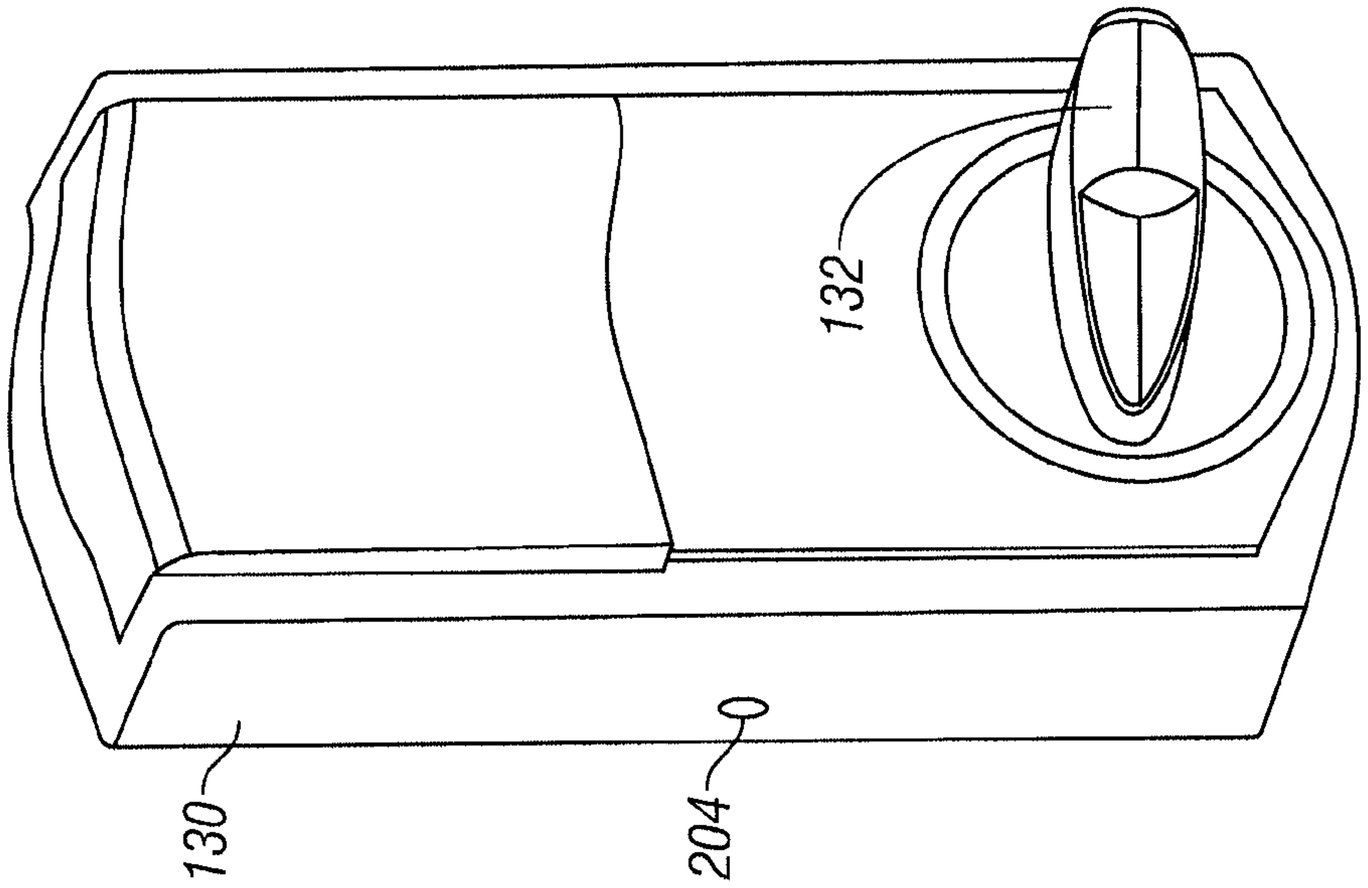

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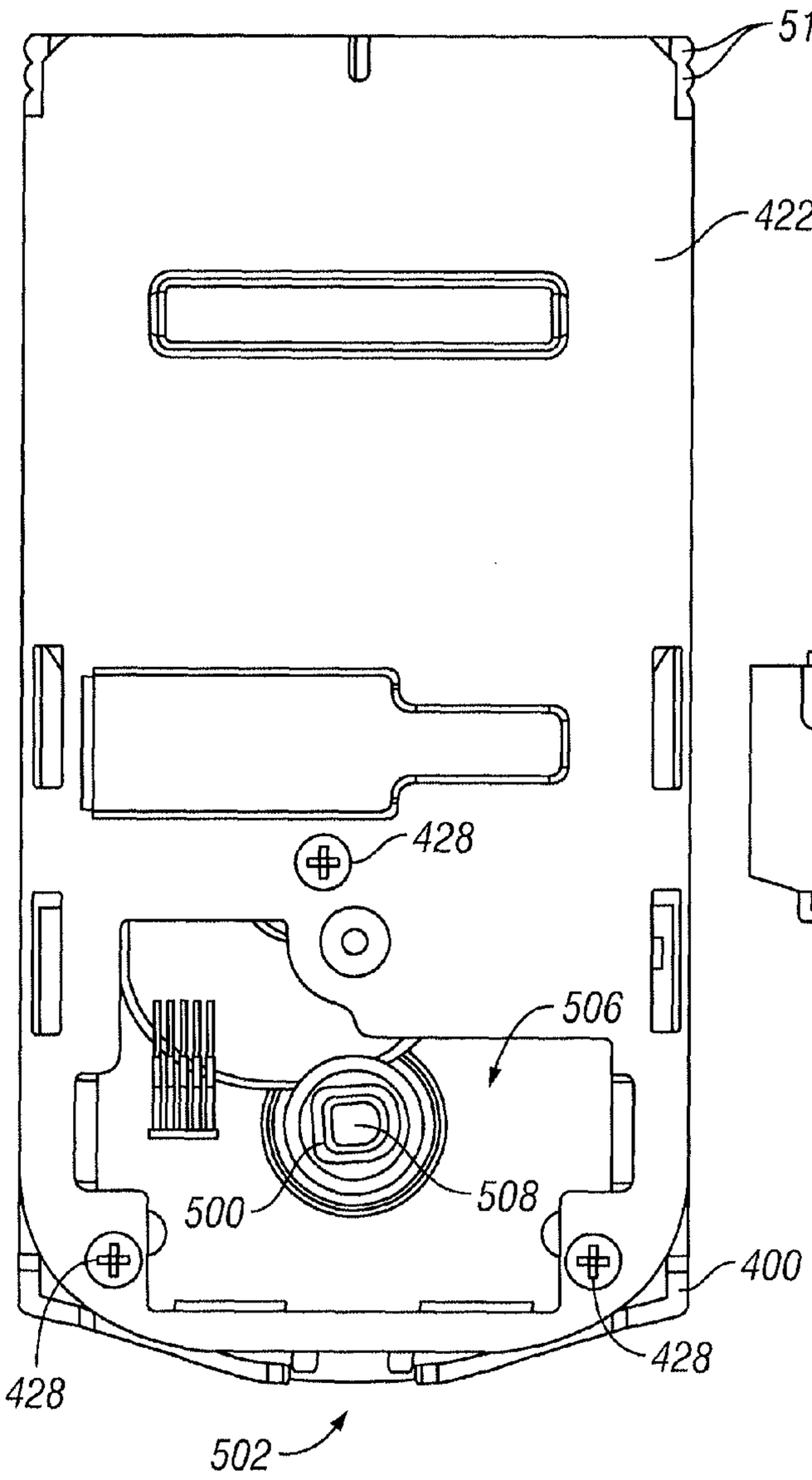


FIG. 11

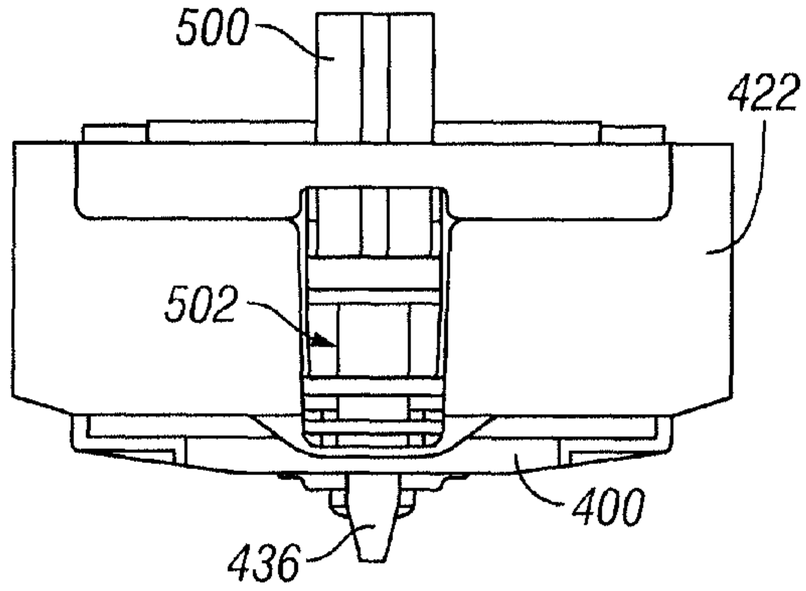


FIG. 12

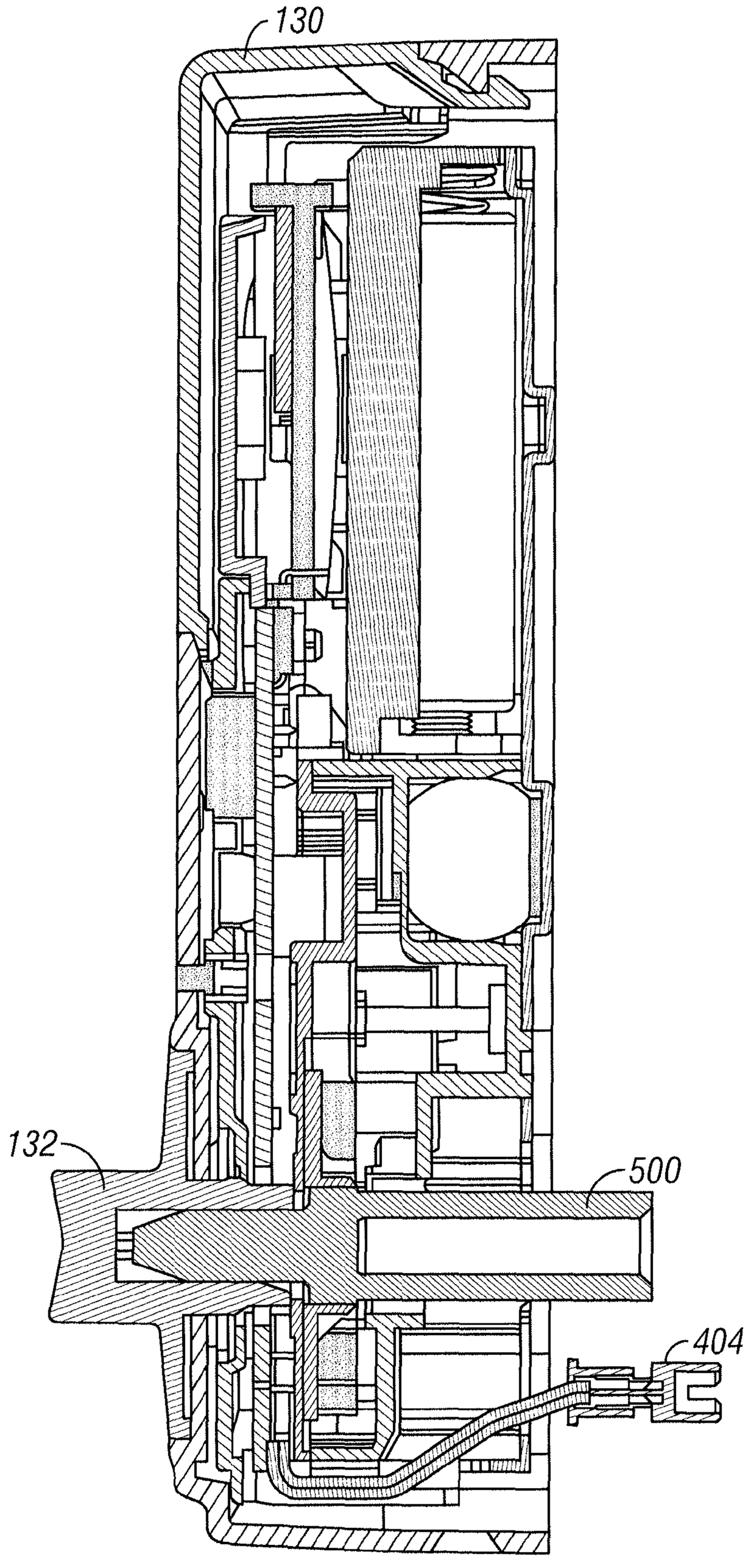
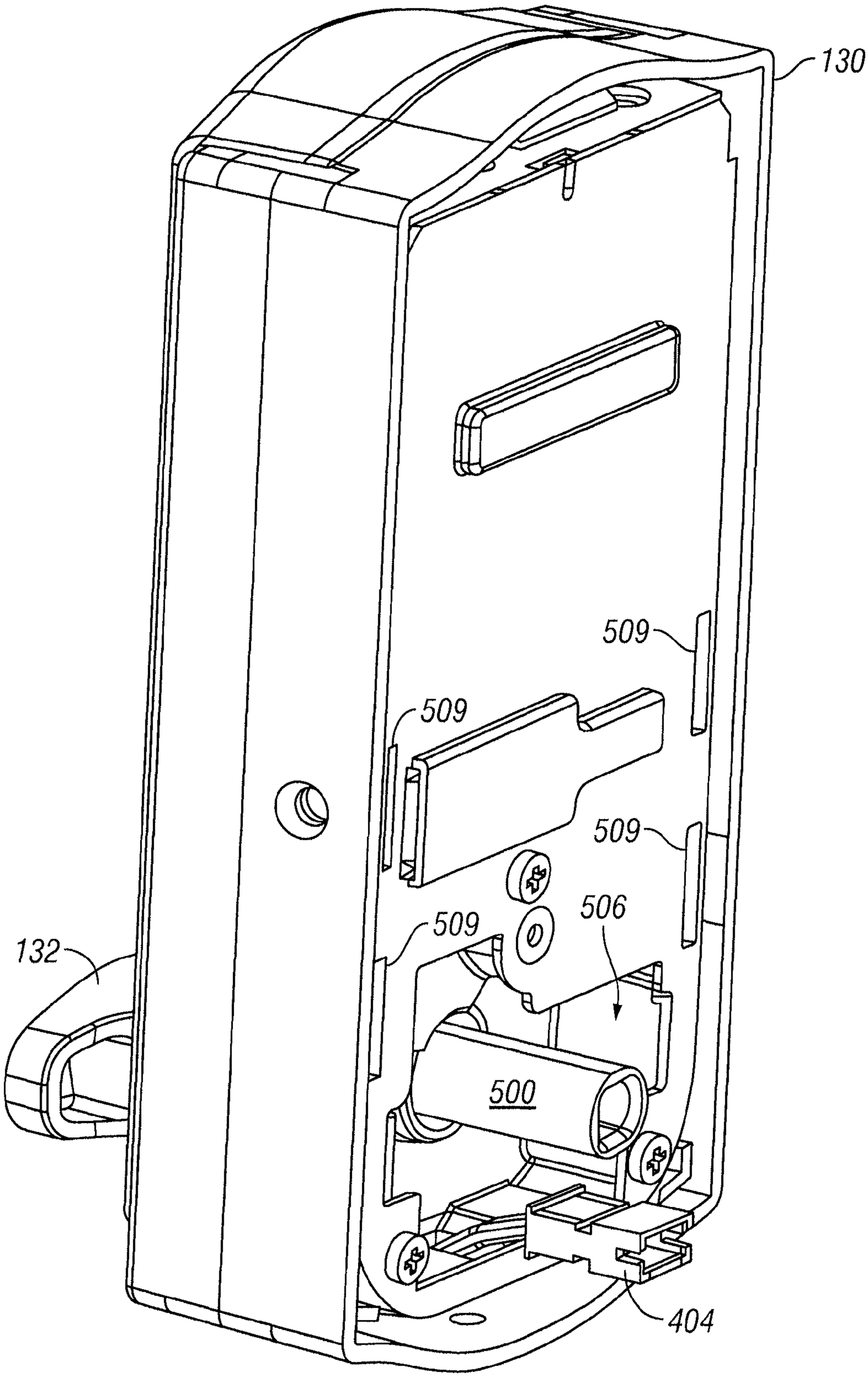


FIG. 13



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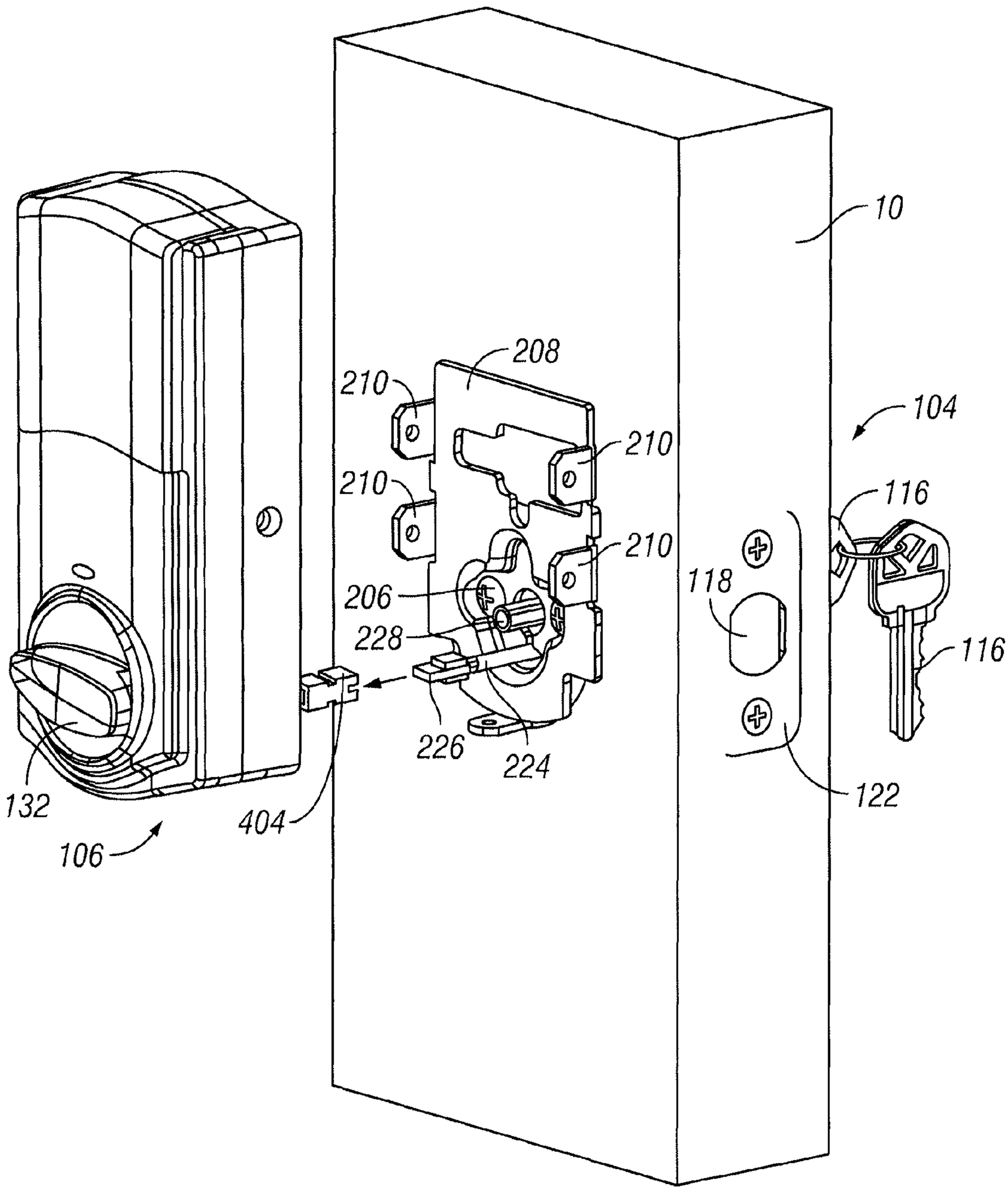
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FIG. 15

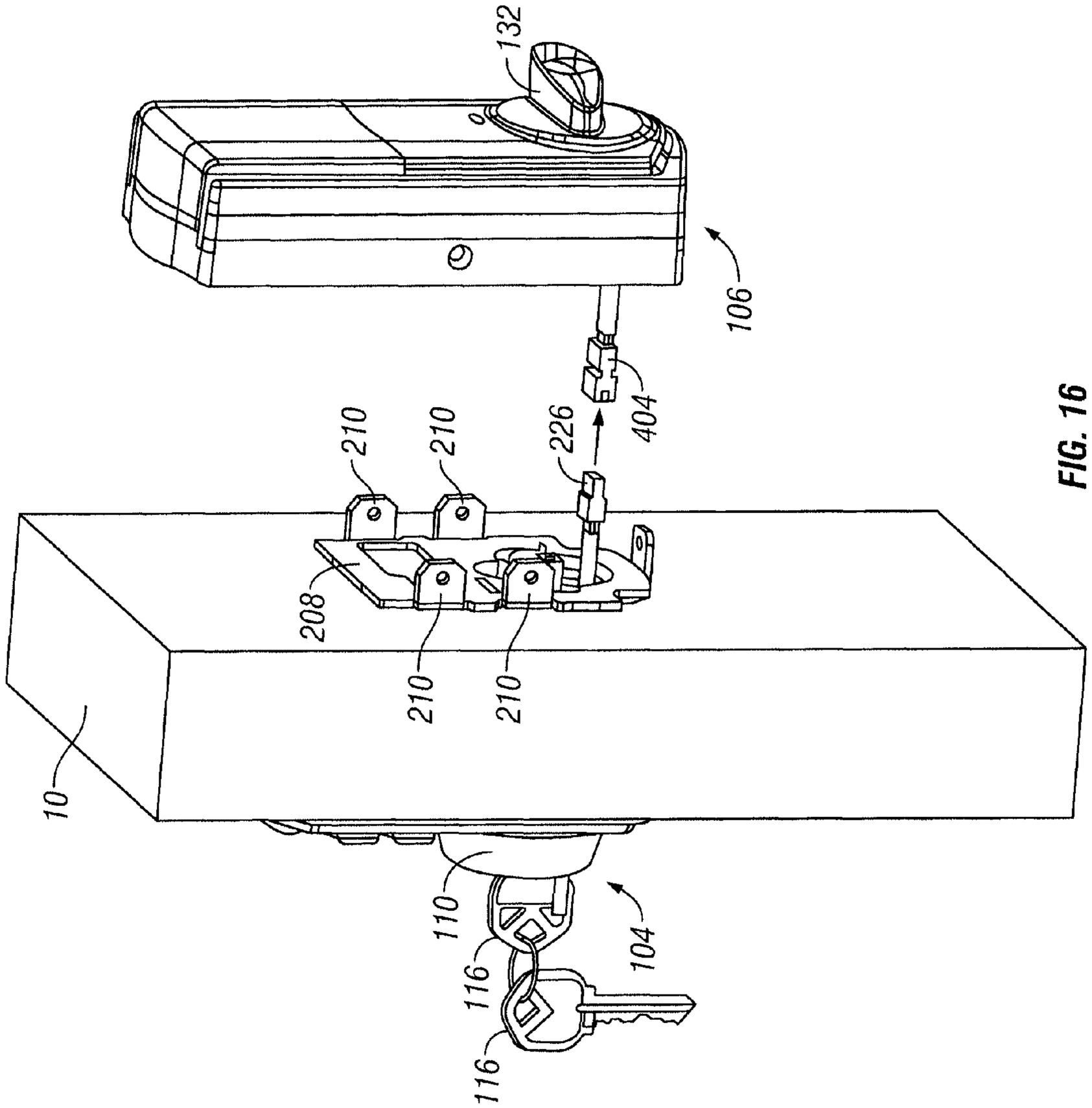
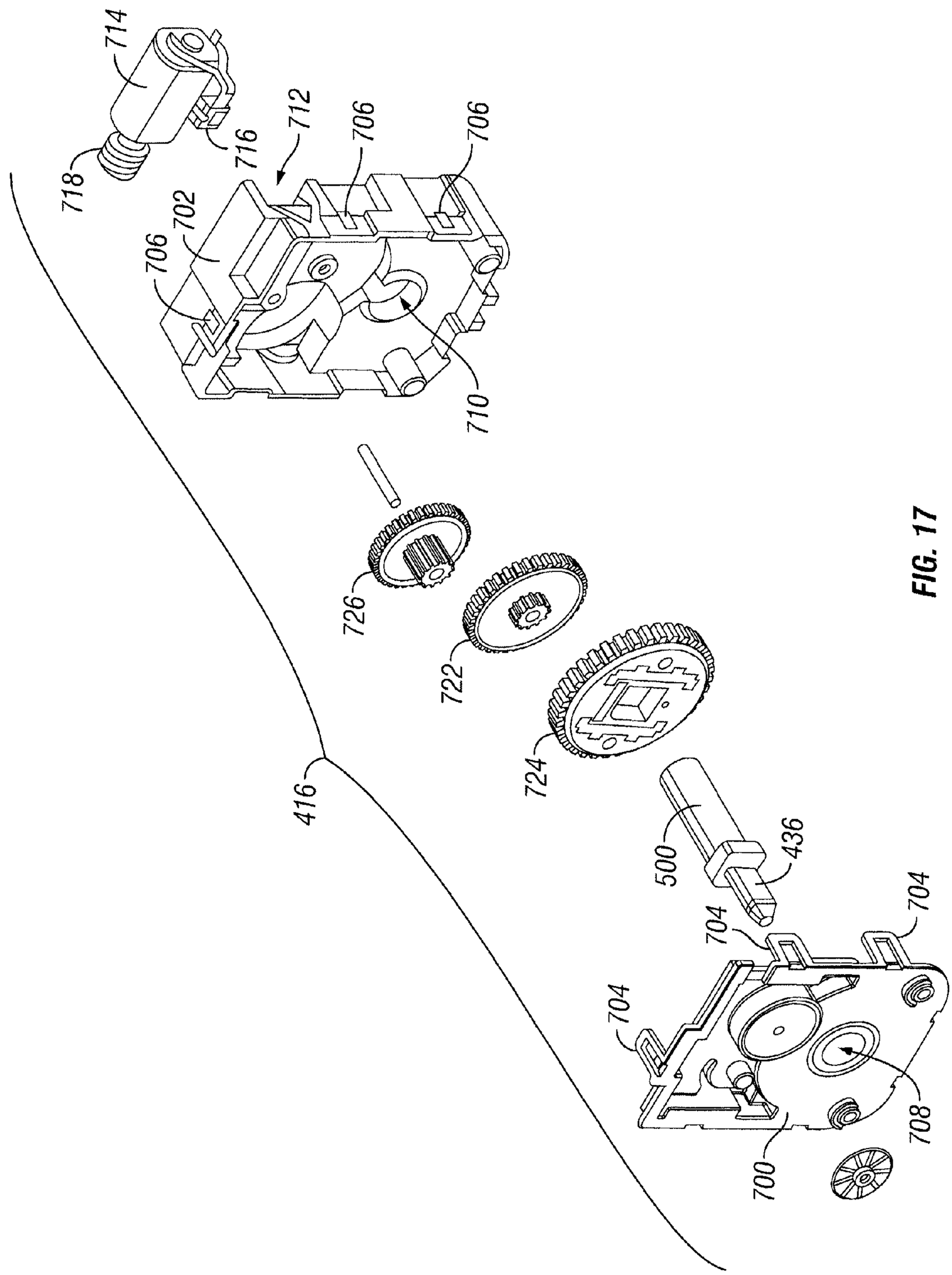


FIG. 16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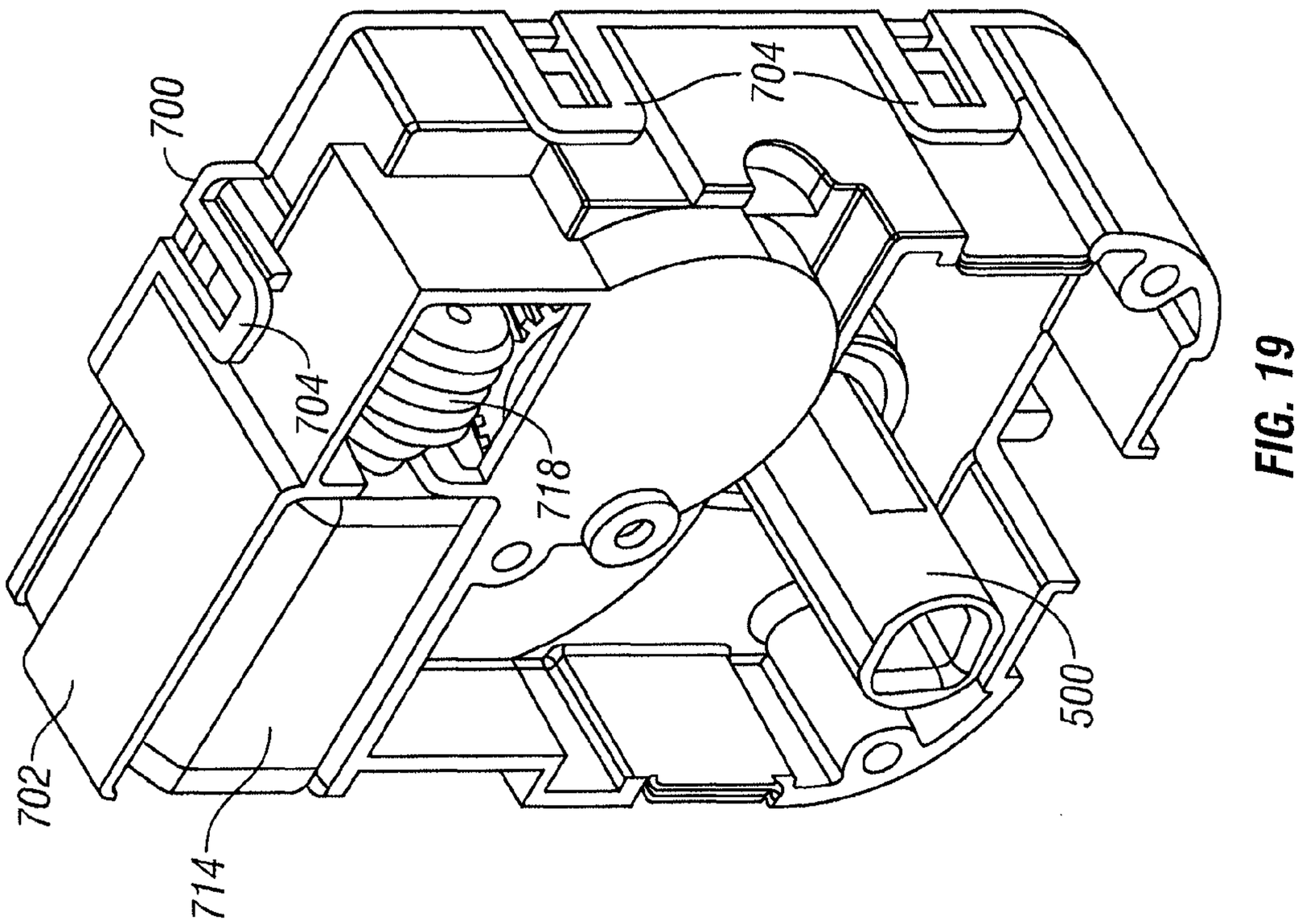
704
708
700

FIG. 17



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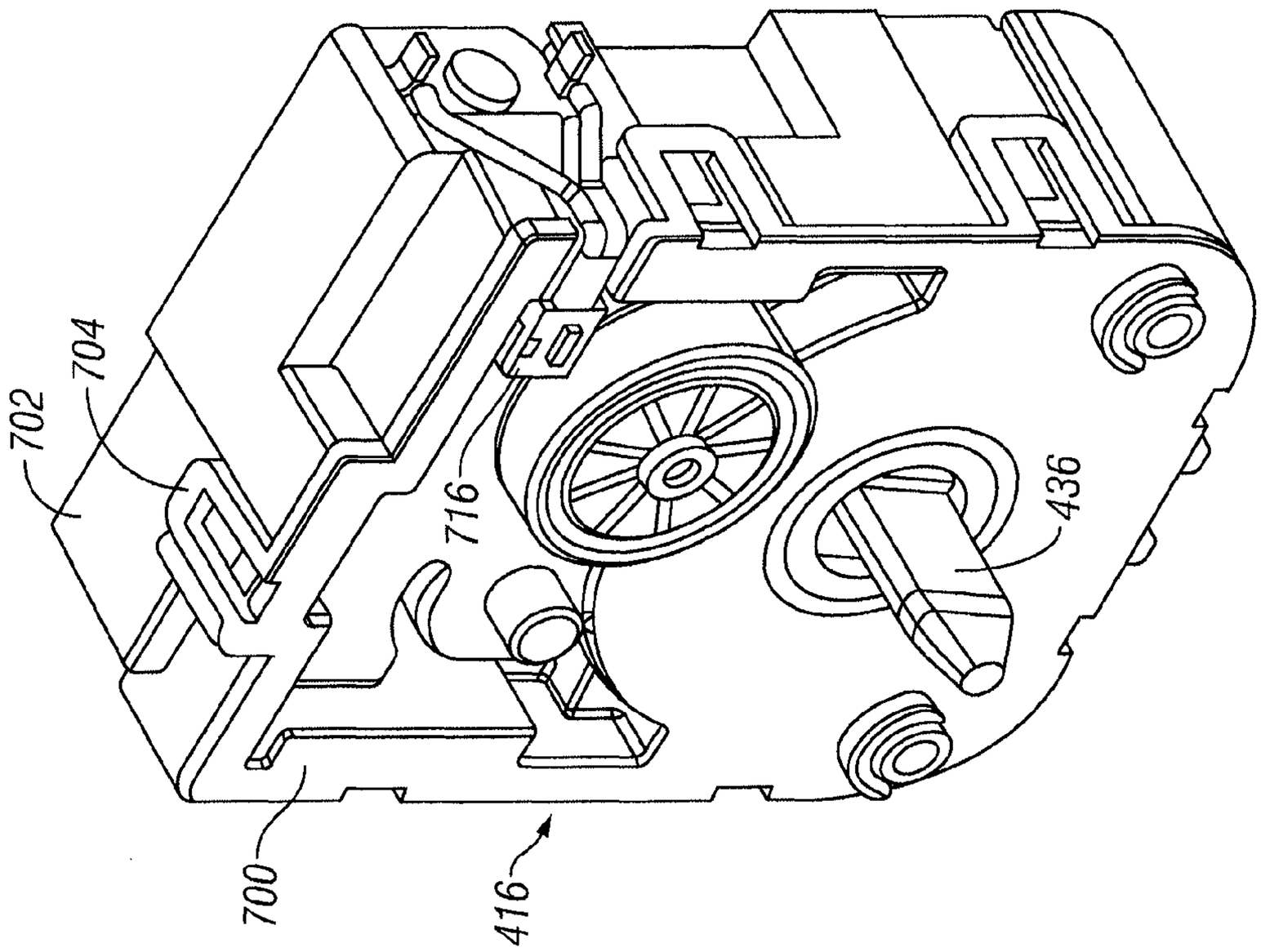

FIG. 18

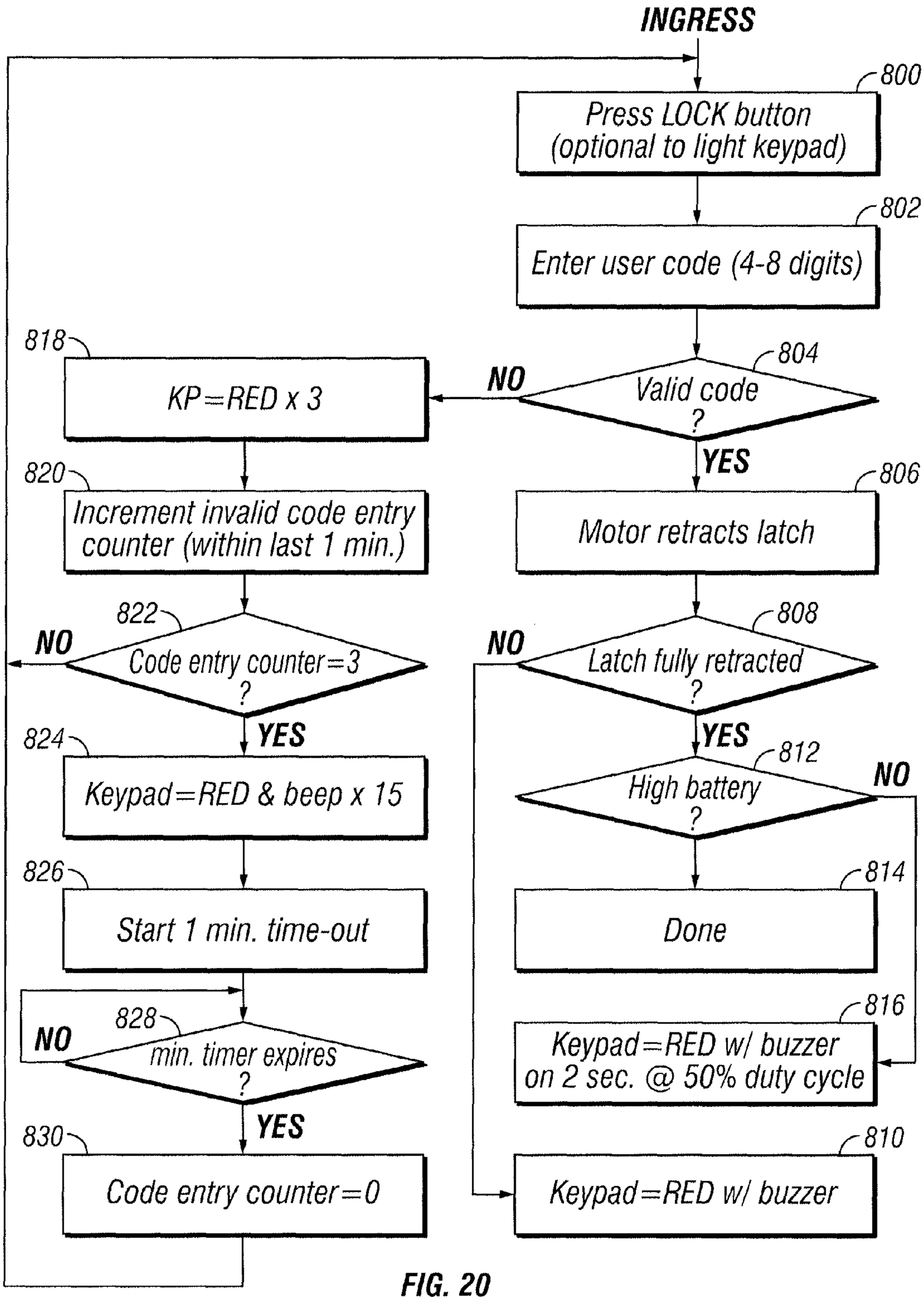
INGRESS
800
Press LOCK button (optional to light keypad)
802
Enter user code (4-8 digits)
804
Valid code ?
NO
YES
818
KP=RED x 3
820
Increment invalid code entry counter (within last 1 min.)
822
Code entry counter=3 ?
NO
YES
824
Keypad=RED & beep x 15
826
Start 1 min. time-out
828
min. timer expires ?
NO
YES
830
Code entry counter=0
806
Motor retracts latch
808
Latch fully retracted ?
NO
YES
812
High battery ?
NO
814
Done
816
Keypad=RED w/ buzzer on 2 sec. @ 50% duty cycle
810
Keypad=RED w/ buzzer

FIG. 20

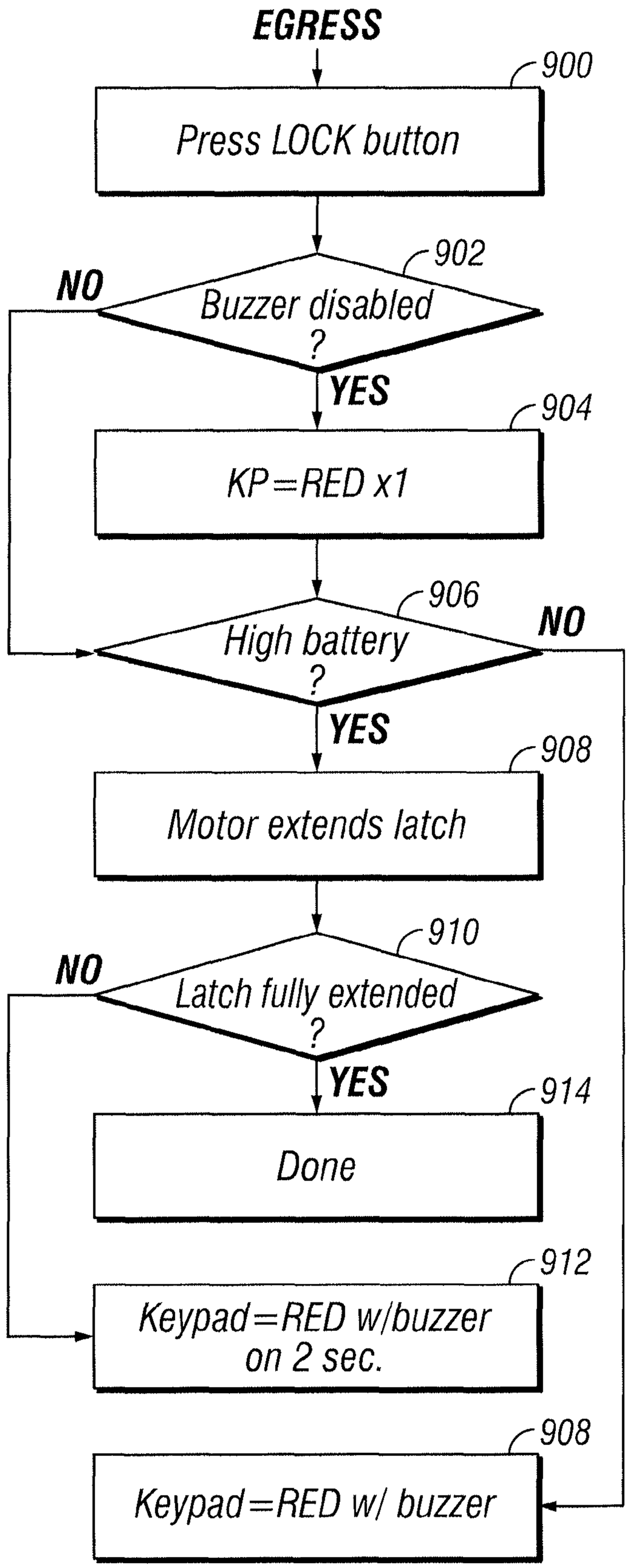
EGRESS
900
Press LOCK button
902
Buzzer disabled ?
NO
YES
904
KP=RED x1
906
High battery ?
NO
YES
908
Motor extends latch
910
Latch fully extended ?
NO
YES
914
Done
912
Keypad=RED w/buzzer on 2 sec.
908
Keypad=RED w/ buzzer

FIG. 21

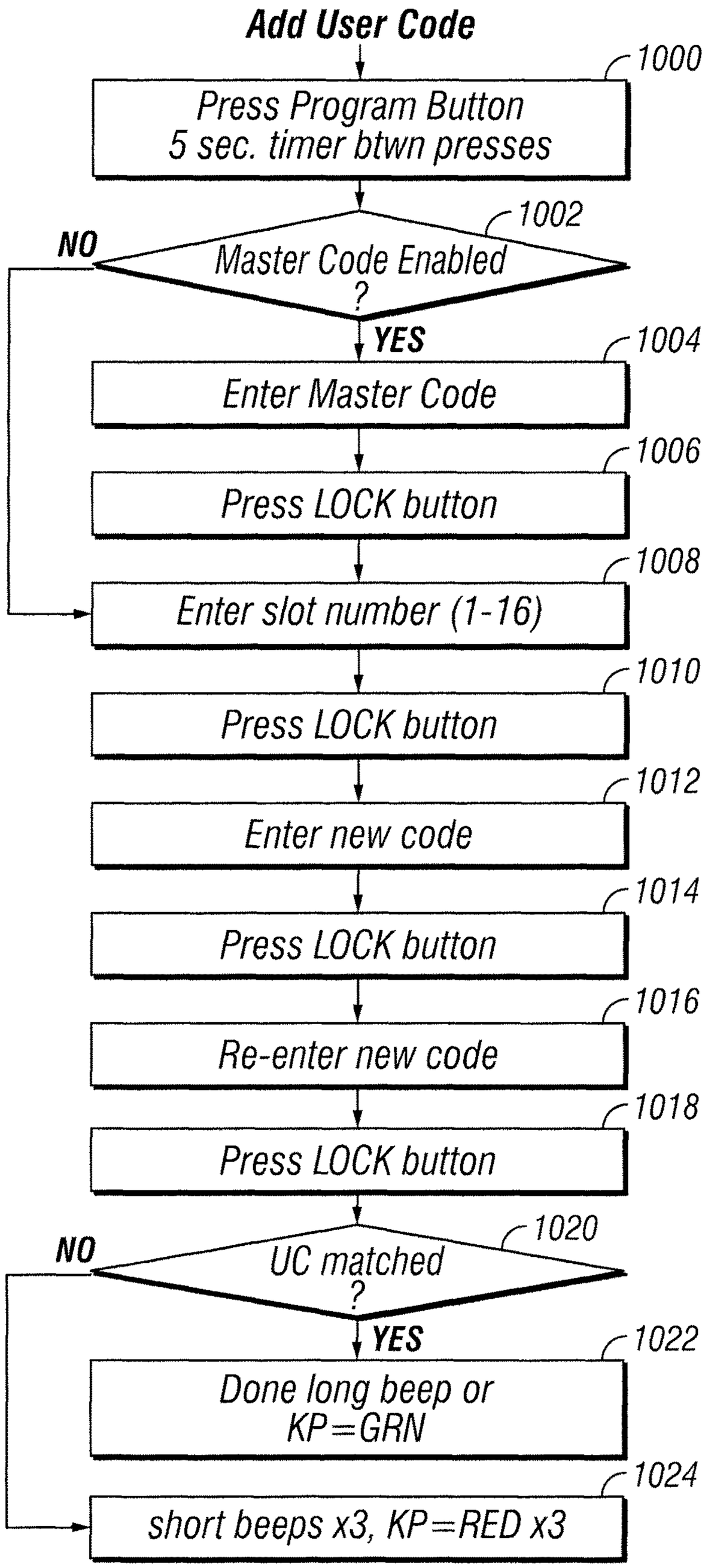
Add User Code
1000
Press Program Button
5 sec. timer btwn presses
1002
NO
Master Code Enabled
?
YES
1004
Enter Master Code
1006
Press LOCK button
1008
Enter slot number (1-16)
1010
Press LOCK button
1012
Enter new code
1014
Press LOCK button
1016
Re-enter new code
1018
Press LOCK button
1020
NO
UC matched
?
YES
1022
Done long beep or
KP=GRN
1024
short beeps x3, KP=RED x3

FIG. 22

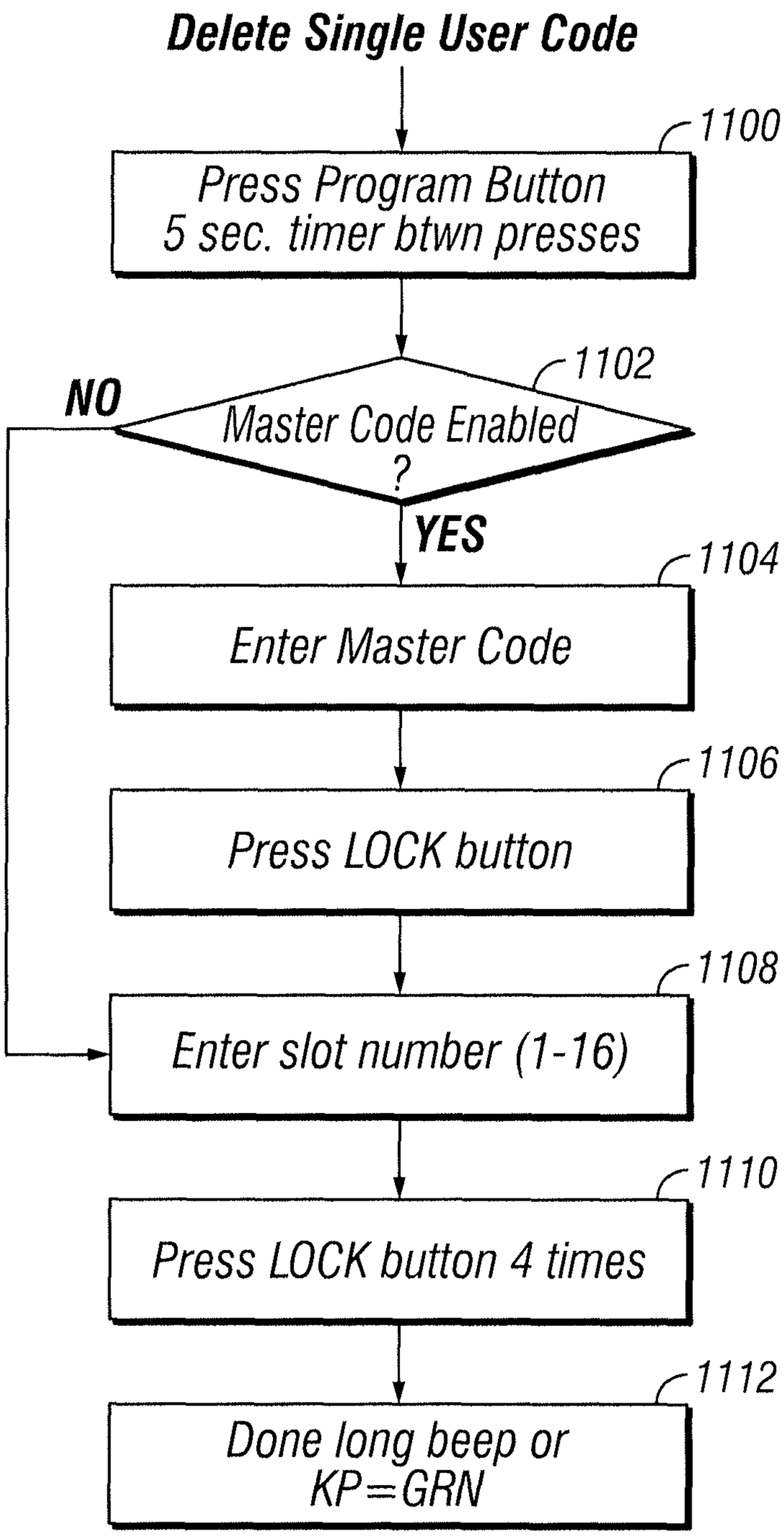
Delete Single User Code
1100
Press Program Button
5 sec. timer btwn presses
1102
NO
Master Code Enabled
?
YES
1104
Enter Master Code
1106
Press LOCK button
1108
Enter slot number (1-16)
1110
Press LOCK button 4 times
1112
Done long beep or
KP=GRN

FIG. 23

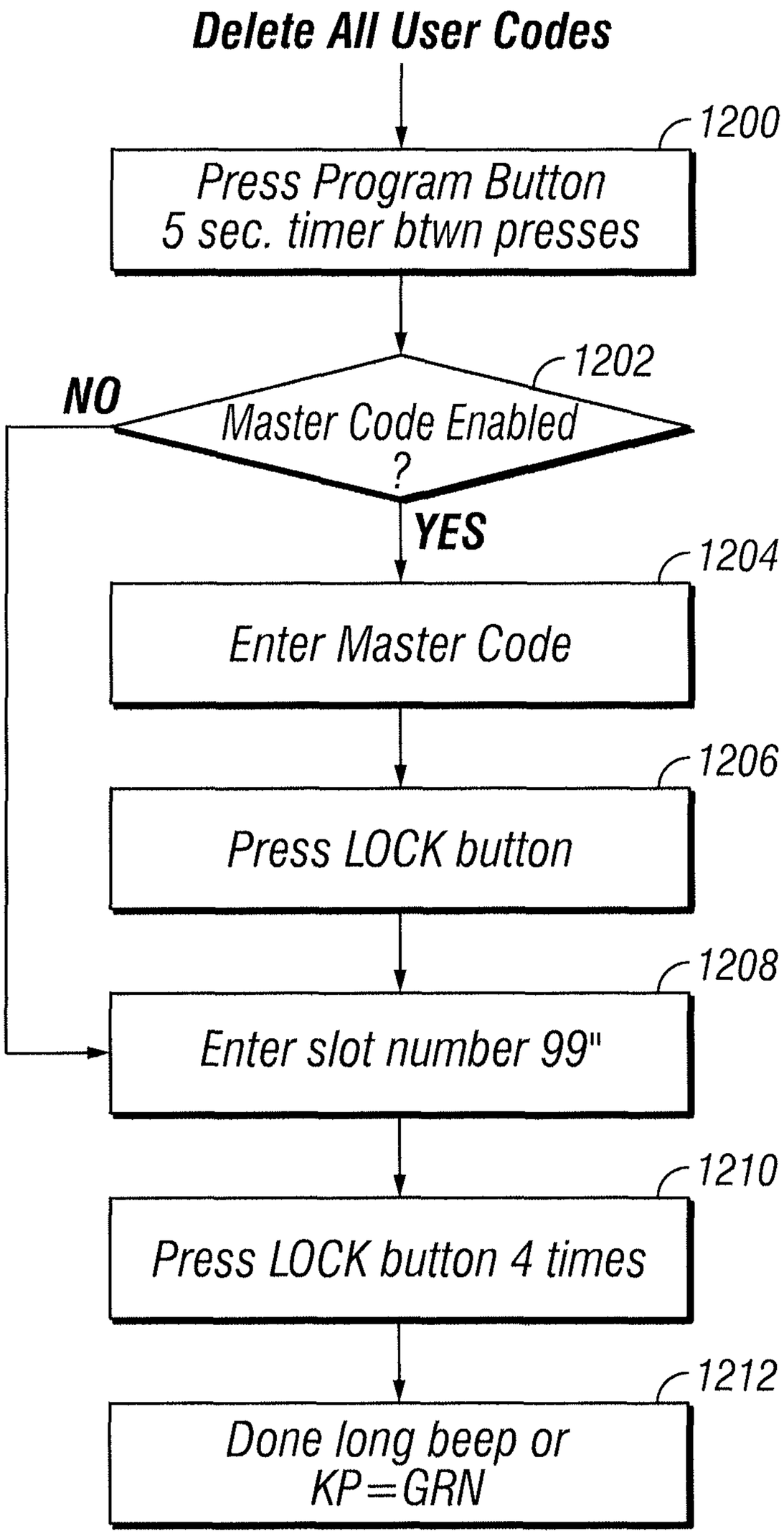
Delete All User Codes
1200
Press Program Button
5 sec. timer btwn presses
1202
NO
Master Code Enabled
?
YES
1204
Enter Master Code
1206
Press LOCK button
1208
Enter slot number 99"
1210
Press LOCK button 4 times
1212
Done long beep or
KP=GRN

FIG. 24

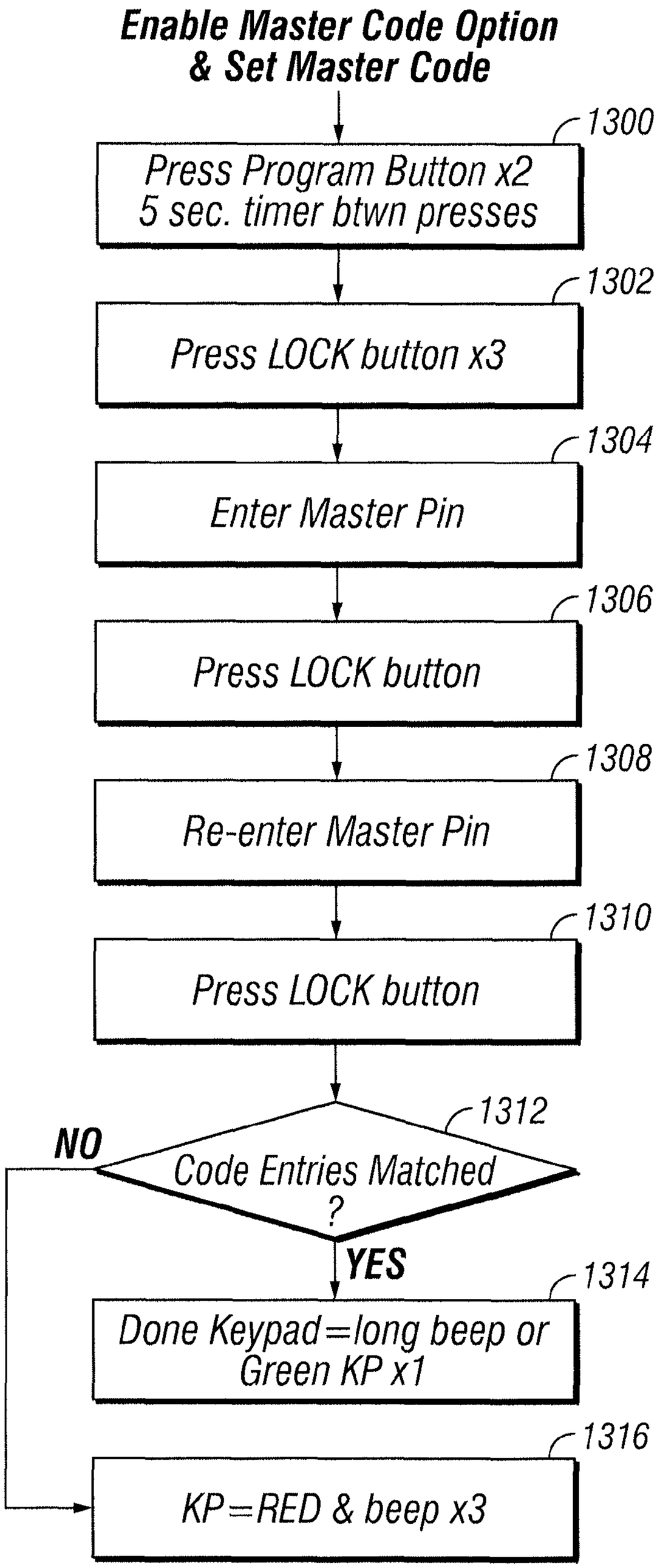
Enable Master Code Option
& Set Master Code
1300
Press Program Button x2
5 sec. timer btwn presses
1302
Press LOCK button x3
1304
Enter Master Pin
1306
Press LOCK button
1308
Re-enter Master Pin
1310
Press LOCK button
1312
Code Entries Matched
?
NO
YES
1314
Done Keypad=long beep or
Green KP x1
1316
KP=RED & beep x3

FIG. 25

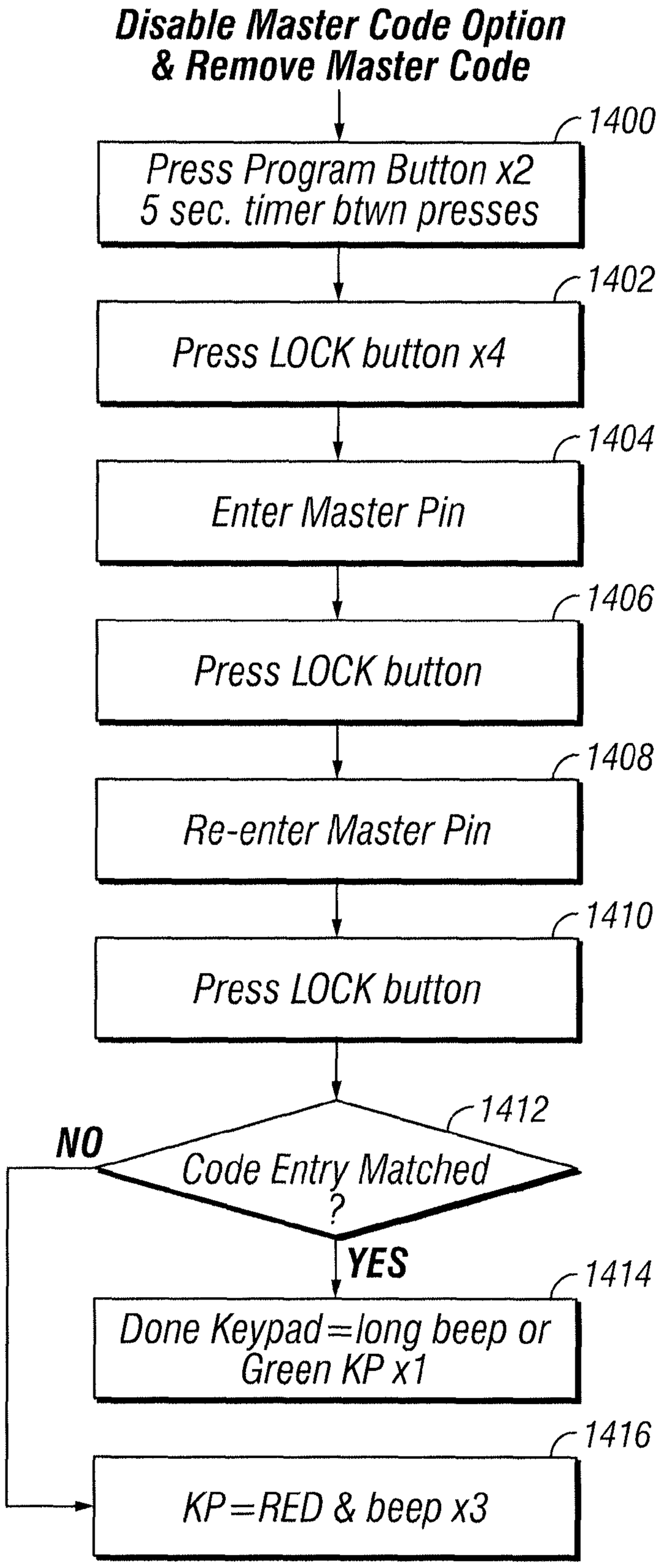
Disable Master Code Option
& Remove Master Code
1400
Press Program Button x2
5 sec. timer btwn presses
1402
Press LOCK button x4
1404
Enter Master Pin
1406
Press LOCK button
1408
Re-enter Master Pin
1410
Press LOCK button
1412
Code Entry Matched
?
NO
YES
1414
Done Keypad=long beep or
Green KP x1
1416
KP=RED & beep x3

FIG. 26

ELECTRONIC DEADBOLT

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Ser. No. 61/776,474, filed Mar. 11, 2013, entitled "Electronic Deadbolt" which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

This disclosure relates generally to electro-mechanical locks; in particular, this disclosure relates to an electronic deadbolt with a compact size that can be easily installed.

BACKGROUND

Electronic deadbolts are well known. Indeed, electronic deadbolts have become increasingly popular for securing access in both residential and commercial settings. Although installation of electronic deadbolts is generally a straightforward task, problems can arise during installation. For example, a wiring harness of the exterior assembly is typically required to be passed through a bore in the door for connection to an interior assembly. In some cases, this can lead to any excess wires from the wiring harness becoming pinched. The electrical connection between the exterior assembly and the interior assembly can also be somewhat difficult in some situations.

With an electronic deadbolt installed, the ability to electrically control the lock can be convenient. From an aesthetic standpoint, however, electronic deadbolts tend to be larger than corresponding mechanical deadbolt locks. Depending on the circumstances, a deadbolt with a more compact size can be aesthetically desirable. Therefore, there exists a need for an electronic deadbolt that can be easily installed and has a compact size.

SUMMARY

This disclosure relates to an electronic deadbolt assembly. According to one aspect, the disclosure provides an electronic deadbolt assembly with a latch assembly having a bolt movable between an extended position and a retracted position. The deadbolt has an exterior assembly and an interior assembly. The exterior assembly has an electronic input device for entering a passcode and a wiring harness in electrical communication with the electronic input device. The interior assembly includes an electronic control assembly configured to move the bolt between the extended position and the retracted position responsive to an authorized passcode being entered in the electronic input device. The interior assembly has an electrical connector in electrical communication with the electronic control assembly that is configured to be connected with the connector on the exterior assembly. In some cases, the electrical connector of the interior assembly extends out of the interior assembly for easier access during installation. In some embodiments, the interior assembly includes a cavity dimensioned to receive at least a portion of the wiring harness to reduce any pinching of the wires between components of the deadbolt assembly. In some embodiments, the electronic deadbolt assembly includes a daughter board with an antenna electrically connected to the main board. The electronic control assembly may include a transmission with a gear train. The main board may be positioned between the interior cover and the gear train, so as to be a front loading main board.

According to another aspect, the disclosure provides an electronic deadbolt assembly comprising a latch assembly, an exterior assembly, an interior assembly, and a mounting bracket. The latch assembly may have a bolt movable between an extended position and a retracted position. The exterior assembly may include an electronic input device for entering a passcode, wherein the exterior assembly includes a wiring harness in electrical communication with the electronic input device. The interior assembly may include an electronic control assembly configured to move the bolt between the extended position and the retracted position responsive to an authorized passcode being entered in the electronic input device. The mounting bracket may include a plurality of tabs extending transversely from a plate portion of the mounting bracket, wherein the interior assembly includes a plurality of recesses dimensioned to receive the tabs in the mounting bracket. In some cases the electronic deadbolt assembly includes a transmission with a gear train having more than two gears.

In some cases, the electronic deadbolt assembly includes an interior cover housing the interior assembly, a turnpiece extending through an opening of the interior cover, and a stem connected to both the turnpiece and an interior driver. The stem may be dimensioned to receive the turnpiece. The interior driver may be configured to manually move the bolt between an extended and retracted position.

According to a further aspect, this disclosure provides an electronic deadbolt with a latch assembly including a bolt movable between an extended position and a retracted position. The deadbolt includes an electronic input device configured to receive an input data and a motor configured to move the bolt between the extended and retracted positions. A controller is provided for controlling actuation of the motor responsive to input data received from the electronic input device. In some embodiments, the controller is switchable between a single user mode and a master mode. In the single user mode, the controller actuates the motor responsive to an authenticated user code while in the master mode the controller actuates the motor responsive to an authenticated master code and an authenticated user code. In some embodiments, the controller is configured to switch between the master mode and the single user mode responsive to input data received from the electronic input device. In some cases, the controller is configured to add and/or delete authenticated user code(s) responsive to input data received from the electronic input device in the master mode.

According to another aspect, the disclosure provides a method of installing an electronic deadbolt. The method includes the step of attaching a mounting plate to an interior side of a door. An electrical connector of a wiring harness of an electronic deadbolt's exterior assembly is moved through a bore in a door. The electrical connector extending through the bore is connected with an electrical connector of the electronic deadbolt's interior assembly. Typically, the electrical connector of the electronic deadbolt's interior assembly extends out a rear portion of the interior assembly for easier installation.

Additional features and advantages of the invention will become apparent to those skilled in the art upon consideration of the following detailed description of the illustrated embodiment exemplifying the best mode of carrying out the invention as presently perceived. It is intended that all such additional features and advantages be included within this description and be within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure will be described hereafter with reference to the attached drawings which are given as non-limiting examples only, in which:

FIG. **1** is a perspective view of the deadbolt assembly according to one embodiment;

FIG. **2** is an exploded view of the deadbolt assembly according to the embodiment shown in FIG. **1**;

FIG. **3** is an exploded view of the exterior assembly according to the embodiment shown in FIG. **1**;

FIG. **4** is an exploded view of the interior assembly according to the embodiment shown in FIG. **1**;

FIG. **5** is a rear perspective view of the interior assembly without the cover attached;

FIG. **6** is a front perspective view of the interior assembly without the cover attached;

FIG. **7** is a top cross-sectional view of the interior assembly;

FIG. **8** is a left side perspective view of the interior assembly;

FIG. **9** is a bottom perspective view of the interior assembly;

FIG. **10** is a right side perspective view of the interior assembly;

FIG. **11** is a rear view of the interior assembly without the cover attached;

FIG. **12** is a bottom view of the interior assembly without the cover attached;

FIG. **13** is a side cross-sectional view of a portion of the interior assembly showing an electrical connector extending out the back of the interior assembly;

FIG. **14** is a detailed rear perspective view of a portion of the interior assembly showing an electrical connector extending out the back of the interior assembly;

FIGS. **15-16** are exploded views of the deadbolt assembly during installation showing an electrical connection to be made between the exterior assembly and the interior assembly;

FIG. **17** is an exploded view of the transmission box according to one embodiment;

FIG. **18** is a front perspective view of the transmission box shown in FIG. **17**;

FIG. **19** is a rear perspective view of the transmission box shown in FIG. **17**; and

FIGS. **20-26** are flow charts showing possible operations or functions that may be performed by the deadbolt assembly according to one embodiment.

Corresponding reference characters indicate corresponding parts throughout the several views. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principals of the invention. The exemplification set out herein illustrates embodiments of the invention, and such exemplification is not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE DRAWINGS

While the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific exemplary embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.

FIG. **1** shows an electronic deadbolt assembly **100** according to one embodiment of the disclosure. The term "electronic deadbolt" is broadly intended to encompass electro-mechanical locks with a bolt that is movable between a locked and unlocked position electronically and/or mechanically, including but not limited to single cylinder, double cylinder, and vertical deadbolts. In the example shown, the electronic deadbolt assembly **100** includes an exterior assembly **102**, a latch assembly **104**, and an interior assembly **106**. Typically, the exterior assembly **102** is mounted on the outside of a door **10** (the door is visible in FIGS. **15** and **16**), while the interior assembly **104** is mounted inside the door **10**. The latch assembly **104** is mounted in a bore formed in the door **10**. The term "outside" is broadly used to mean an area outside a door and "inside" is also broadly used to denote an area inside a door. With an exterior entry door, for example, the exterior assembly **102** may be mounted outside a building, while the interior assembly **106** may be mounted inside the building. With an interior door, the exterior assembly may be mounted inside a building, but outside a room secured by the deadbolt assembly **100**; the interior assembly may be mounted into the secured room. The deadbolt assembly **100** is applicable to both interior and exterior doors.

In the example shown, the exterior assembly **102** has an exterior rose **108** that houses the exterior assembly **102**. As shown, the exterior rose **108** has a decorative rectangular shape, but round, square, and other shapes for the exterior rose **108** are within the scope of the disclosure. A keypad **111** with a plurality of buttons **112** extend through the exterior rose **108** in the example shown. The buttons **112** may be used to enter a passcode for unlocking the deadbolt assembly **100** or otherwise control operation. Although a keypad **111** with buttons **112** is shown for purposes of example, other input devices could be used, including but not limited to a touch screen, biometric sensor, microphone, etc. A cylinder guard **110** extends from the exterior rose **108** to protect and reinforce a mechanical locking assembly **114**. In the example shown, the cylinder guard **110** is formed integral with the exterior rose **108**, but could be a separate component. A mechanical key **116** may be inserted into the mechanical lock assembly **114** to mechanically unlock the deadbolt assembly **100**. Accordingly, in the embodiment shown, the exterior assembly **100** may be used to unlock the deadbolt assembly **100** either electronically using the keypad **111**, or mechanically using a mechanical key **116**.

The latch assembly **104** is disposed in a core in the door **10** and may be actuated manually by the mechanical lock assembly **114**, or electronically using the keypad **111** to extend and retract a bolt **118**. The bolt **118** moves linearly in and out of a sleeve **120**. When the bolt **118** is retracted, an end of the bolt **118** is generally flush with a base plate **122**. When the bolt **118** is extended, the bolt **118** protrudes through an edge bore in the door **10** into an opening **126** of a strike plate **124**, which is positioned in a jamb adjacent the door **10**. As is typical, the strike plate **124** is attached to the jamb using fasteners **128**.

The interior assembly **106** includes an interior cover **130** that houses internal components of the internal assembly **106** as explained below. A turnpiece **132** may be rotated by a user to manually extend and retract the bolt **118**.

FIG. **2** is an exploded view of the deadbolt assembly **100** according to the embodiment shown in FIG. **1**. As seen in this example, the interior assembly **106** includes a light **200** that provides status information regarding the deadbolt assembly **100**. For example, the light **200** may indicate if the bolt **118** is unlocked, such as by illuminating a green color and could indicate if the bolt **118** is locked, such as by illuminating a red color. These are merely examples of possible status information that could be indicated by the light **200**, but other possibilities exist. In the embodiment

shown, the interior cover **130** includes a radio frequency ("RF") transparent portion **202**, which allows RF signals to be transmitted out of the interior assembly **106**. For example, the deadbolt assembly **100** may wirelessly communicate with other electronic devices, which could allow the deadbolt assembly to be remotely controlled, such as using a mobile device. In one embodiment, the RF transparent portion **102** could be made of Lexan® available from SABIC Innovative Plastics of the Netherlands. In this example, a plurality of fasteners **204** connect the interior assembly **106** together.

A mounting plate **208** is mounted to an interior portion of a door using fasteners **206**. In this example, the mounting plate includes a plate portion **209** defining openings **212** through which the fasteners **206** extend to be attached with threaded interior threads of openings **216** in the latch assembly **104**. As shown, the mounting plate **208** includes tabs **210** that extend from the plate portion for connecting the interior assembly **106** to the door **10**. A pass-through **214** defined in the plate portion **209** is dimensioned to receive a wiring harness **224** with an exterior connector **226** and torque blade **228** from the exterior assembly **102** that extends through a spindle drive **218** on the latch assembly **104**. As explained below, rotation of the torque blade **228** within the spindle drive **218** in a first direction causes the bolt **118** to extend and rotation of the torque blade **228** in the opposing direction causes the bolt **118** to retract. For example, the torque blade **228** could be manually rotated using the turnpiece **132**, or mechanical lock assembly **114**, or electronically controlled with a motor responsive to a user entering an authorized pass code using the keypad **111** (discussed below) to extend/retract the bolt **118**. As shown, the exterior assembly **102** includes an adaptor **222** that is dimensioned to be received by the bore in the door that extends from a back plate **220**.

FIG. **3** is an exploded view of the exterior assembly **102** according to the embodiment shown in FIG. **1**. As shown, a mechanical lock assembly **114** with a lock cylinder **300** extends into an opening **302** defined in the cylinder guard **110**. To mechanically lock/unlock the bolt **118** with the mechanical lock assembly **114**, a user would insert a mechanical key **116** into the lock cylinder **300** and rotate the lock cylinder **300**, which rotates the torque blade **228**. In the example shown, the rose **108** includes a plurality of holes **304** aligned to receive the buttons **112** of the keypad **111**. A clip **306** is provided to secure the lock cylinder **300** to the exterior rose **108**. The buttons **112** extend from a circuit board **308** that transmits electrical signals based on user actuation of the keypad **111** to a controller in the interior assembly **106** using a wiring harness **224**. In some cases, a wedge **309** may be provided to fill and dampen any gap between the exterior rose **108** and the circuit board **308**. In this example, a plurality of fasteners **310** secure the back plate **220** and circuit board **308** to the rose **108**. As shown, holes **312** in the back plate **220** are aligned with holes **314** in the circuit board **308** and fasteners **310** extending therethrough. In the embodiment shown, the circuit board **308** includes an opening **316** that is aligned with an opening **318** in the back plate **220**, which aligns with an opening **320** in the adaptor **222** so that the torque blade **228** and wiring harness **224** may extend therethrough.

FIG. **4** is an exploded view of the interior assembly **106**. In the example shown, the interior assembly **106** includes a PCB cover **400** that is connected with a main board **402**, which is a circuit board having a controller or processor that is programmed for one or more of the functions described herein. In this example, the main board **102** is in electrical communication with a connector **404** that is configured to be connected with the connector **226** from the exterior assembly **102**. As shown, the main board **402** includes a button **406** that allows the controller to be programmed with various modes and be customized by the user. A bank of switches **408** allows the user to customize settings for the controller.

In this example, the PCB cover **400** is also connected to a daughter board holder **410** that secures a daughter board **412**. The daughter board **412** may include an antenna, such as a Zigbee antenna for transmitting radio frequency signals to other electronic devices. The daughter board **412** connects to the main board **402** using connectors **414** so that the daughter board **412** is in electrical communication with the main board **402**. In the example shown, the PCB cover **400** includes an opening **432** that is alignable with an opening **434** in the main board **402** so that a stem **436** may pass therethrough. The stem **436** may be connected to the turnpiece **132** so that rotation of the turnpiece **132** rotates the stem **436**.

In the embodiment shown, a transmission box **416** is also attached to the PCB cover **400**. In the example shown, a plurality of fasteners **426** attaches to the main board, daughter board holder **410**, and transmission box **416** to the PCB cover **400**. In some cases, a vibration pad **420** may be provided to dampen any vibrations caused by the transmission box **416**. These components are connected with a back plate **422** using tabs on the daughter board holder **410** in the example shown.

The back plate **422** houses a battery holder assembly **424**, which is configured to hold a plurality of batteries for providing electrical power to electronic components in the deadbolt assembly **100**. In the embodiment shown, the back plate **422** includes an extension **438** with holes **440** alignable with holes in tabs **210** of the mounting plate **208**. Fasteners **430** may be used to secure these components to the mounting plate **208**.

FIG. **5** is a rear perspective view of the interior assembly **106** without the interior cover **130** connected. In this view, a connection between the back plate **422** and the daughter board holder **420** can be seen. In the embodiment shown, the back plate **422** includes a detent portion **504** that receives a flange extending from the daughter board holder **410**. In this example, a cavity **506** is formed in the rear portion of the interior assembly **106** that is dimensioned to hold any excess portion of the wire harness **224** to prevent any pinching thereof. An interior driver **500** extends from the stem **436** and includes an opening **508** that is dimensioned to receive the torque blade **228**. Accordingly, rotation of the turnpiece **132** rotates the stem **436** which causes the torque blade **228** to rotate. The rotation of the torque blade **228** actuates the spindle drive **218** in the latch assembly **104** to lock or unlock the deadbolt assembly **100**. Accordingly, a user may manually lock or unlock the deadbolt assembly **100** by rotating the turnpiece **132**. In the embodiment shown, the back plate **422** includes an opening **502** through which the connector **404** may extend out through the cavity **506** to provide easy access for a connection with the exterior connector **226**.

In this view, a threaded opening **440** is defined in the back plate **422** to receive the fasteners **430** (FIG. **4**). In the example shown, the back plate **422** defines slots **509** that are arranged and dimensioned to receive tabs **210** in the mounting plate **208**. With the tabs **210** extending into slots **509**, this aligns holes in tabs **210** with opening **440** for fasteners **430** to extend therethrough. In this example, fasteners **430** and **204** extend into openings **440** and **441**, respectively, in back plate **422** and through holes in tabs **210** of mounting plate **208**. With the interior cover **130** placed over the interior assembly, holes **441** in the back plate align for fasteners **204**

to extend through the tabs **210** in the mounting plate **208** (see FIGS. **8-10**). Openings for the fasteners **428** can also be seen. In the example shown, the battery holder assembly **424** includes a plurality of ridges **510** to aide the user in removing the battery holder assembly **424** from the interior assembly **106** when the batteries need to be replaced.

FIG. **6** is a front perspective view of the interior assembly **106** without the interior cover **130** attached. In the example shown, the stem **436** can be seen extending through the main board **402**. As shown, the stem **436** has an approximately triangular cross-section. This shape for the stem **436** allows the attachment with the turnpiece **132** to self-align to allow easier installation for the user.

FIG. **7** is a cross-sectional view cut along a horizontal axis to show the connection of the interior assembly **106** to the mounting plate **208**. As can be seen, the fasteners **430** connect to the back plate **422** of the interior assembly without the interior cover **130** to the tabs **210** on the mounting plate **208**. These fasteners **430** may be low profile and extend inside of the interior cover **130**. The fasteners **204** then attach the interior cover **130** to the back plate **422** and mounting plate **208**. FIGS. **8-10** show this connection of fasteners **204** to the interior cover **130**. Connecting the interior assembly **106** using fasteners that are connected to tabs transverse to the door takes up less space for a smaller footprint.

FIGS. **11** and **12** show a rear view and bottom view of the interior assembly **106** without the interior cover **130** connected, respectively. In this example, the back plate **422** defines an opening **502** through which the interior connector **404** extends from the main board **402** and then out the opening **506** for attachment to the external connector **226**. The interior connector **404** allows the connection to the exterior connector **226** to be remote from the main board **402**, this allows for a more compact assembly in which the wiring harness **224** does not need to be connected directly to the main board **402**. FIGS. **13** and **14** show additional views of the interior connector **404** extending out of the cavity **506** for connection to the wiring harness **224** via the exterior connector **226**.

FIGS. **15** and **16** are perspective views showing the deadbolt assembly **100** during installation prior to connection of the exterior connector **226** to the interior connector **404**. In the example shown, the exterior connector **226** is a male connector and the interior connector **404** is a female connector. However, this is merely for purposes of example and other types of connectors could be used. As shown, the exterior connector **226** extends through a bore in the door **10** for connection to the interior connector **404**. Any excess wiring may be housed within the cavity **506** of the interior assembly **106**.

FIG. **17** is an exploded view of the transmission box **416**. In the example shown, the transmission box **416** includes a front cover **700** that connects with a rear cover **702**. In the example shown, the front cover **700** includes tabs **704** with openings that receive ridges **706** defined on an exterior surface of the rear cover **702**. The front cover **700** includes an opening **708** that corresponds with an opening **710** in the rear cover **702**. The opening **708** is dimensioned to receive the stem **436**, while the opening **710** in the rear cover **702** is dimensioned to receive the interior driver **500**. The rear cover **702** includes a recessed area **712** that is dimensioned to receive a motor **714**. The motor includes an electrical connector **716** on one end and a worm shaft **718** on an opposing end. The worm shaft **718** is configured to engage a first gear **720** which engages a second gear **722** that is coupled with a third gear **724**. The rotation of the third gear **724** causes rotation of the interior driver **500** and stem **436**.

The motor **714** is in electrical communication with the main board **402** using the electrical connector **716** so that the controller or processor on the main board **402** can control operation of the motor **714**. For example, if the controller on the main board **402** received an authorized passcode from a user entering the code using the keypad **111**, the controller would actuate the motor **714**, which would in turn rotate the interior driver **500**. The rotation of the interior driver **500** causes rotation of the torque blade **228**, which actuates the spindle drive **218** on the latch assembly **104**, thereby retracting or extending the bolt **118**. The gear train **720**, **722**, and **724** uses three gears in this embodiment instead of the typical use of two gears. The use of more than two gears requires less torque, which allows the use of a smaller motor **714**, thereby decreasing the package of the transmission box **416**. FIGS. **18** and **19** show front and rear perspective views of the transmission box, respectively.

FIGS. **20-26** are flowcharts showing operation of the deadbolt assembly **100** based on user interaction with keypad **111** and/or the programming button **406**. In some embodiments, a controller or processor on the main board **402** is programmed with one or more of the operations or processes discussed in the flowcharts.

FIG. **20** shows steps that may occur when a user is attempting to enter a secure area (ingress) by unlocking the deadbolt assembly **100**. If it is dark outside or in the area in which the exterior assembly **102** is located, the user may press a button on the keypad **111**, such as the lock button, to light the keypad (block **800**). The user will then enter a passcode or user code by pressing a sequence of buttons **112** on the keypad. (Block **802**) If the passcode is valid (block **804**), the motor **714** retracts the latch. (Block **806**) If the latch does not retract fully (block **808**), an error code may be shown to the user, such as by having the keypad turn red and/or an audible buzzer sounding (block **810**). If the latch does fully retract, a check is made on the battery level (block **812**). If the voltage on the battery is above a predetermined level, the process is done (block **814**). If the battery voltage is below a predetermined level, an error message may alert the user that the battery should be replaced, such as by flashing the keypad and/or sounding an audible buzzer (block **816**). If the user fails to enter a valid code (block **804**), an audible warning may be provided to the user, such as by flashing the keypad red (block **818**). A count is kept as to the number of incorrect codes that are entered by the user, which is incremented by one (block **820**). If the number of invalid passcodes entered within a certain predetermined time period exceeds a predetermined number, such as three, the user will be alerted that the system has gone into lockout mode (block **824**) and has started a timer (block **826**). When the timer expires (block **828**), the counter is reset (block **830**) and the user may try to enter an additional passcodes to unlock the deadbolt assembly.

FIG. **21** shows possible steps that may be taken by the controller when a user is attempting to lock the deadbolt assembly **100** using the exterior assembly **102** (egress). In such a circumstance, the user would select the lock button (block **900**). If the buzzer is disabled (block **902**), the keypad may flash. (Block **904**) A check is made to determine whether the voltage of the battery is above a predetermined threshold. (Block **906**) If the battery is below the predetermined threshold, the user is alerted that the battery needs to be replaced, such as by flashing the keypad red. (Block **908**) Otherwise, the motor **714** extends the latch to lock the deadbolt assembly **100**. (Block **908**) If the latch does not

fully extend (block **910**), the user will be alerted by an error message, such as by flashing the keypad red and/or with an audible buzzer (block **912**). Otherwise, the deadbolt assembly is locked and the process is done. (Block **914**)

FIG. **22** shows possible steps that may be taken in an embodiment in which the controller is programmed with a master mode. In this example, the user may enter into a mode to add additional user codes by selecting the programming button **406** on the main board **402**. (Block **1000**) If the master mode is enabled (block **1002**) the master code must be entered (block **1004**) and the lock button pressed (block **1006**). Otherwise, the slot number for the user code may be entered using the keypad (block **1008**) and the lock button entered (block **1010**). The new user code may then be entered (block **1012**) by pressing the lock button (block **1014**). For confirmation, the new code must be reentered in this example (block **1016**) and then selecting the lock button (block **1018**). If the user code matches the code stored in memory (block **1020**), the user is notified of this fact, such as by a long beep and/or flashing the keypad a green color (block **1022**). If not, the user is notified that the new user code was not added, such as by an audible beep and/or flashing the keypad red (block **1024**).

FIG. **23** is a flowchart showing an example process for deleting a single user code. In this example, the user may enter this mode by selecting the programming button **406** for a predetermined length of time (block **1100**). If a master mode is enabled (block **1102**), the master code must be entered (block **1104**) and the lock button entered (block **1106**). The slot number of the user code to be deleted is then entered (block **1108**) and the lock button pressed a certain number of times in this example (block **1110**). The system will acknowledge that the user code has been deleted, such as by a long beep and/or flashing the keypad green (block **1112**).

FIG. **24** is a flowchart showing a process by which all user codes can be deleted at one time. One way to enter this mode, for example, could be pressing the programming button **406** for a certain period of time, such as five seconds (block **1200**). If the master mode is enabled (block **1202**), the master code must be entered (block **1204**) and the lock button pressed (block **1206**). The slot number to delete all user codes could be a unique number or key sequence, such as "99." (Block **1208**) After pressing the lock button a predetermined number of times, such as four times (block **1210**), the system may acknowledge that all user codes have been deleted, such as by audibly making a long beep and/or flashing the keypad a green color (block **1212**).

FIG. **25** shows an example process by which the master mode option can be enabled and the master code set. In this example, entering this mode may be made by pressing the programming button **406** multiple times for a certain period of time (block **1300**). In this example, the next step is pressing the lock button a certain number of times, such as three times (block **1302**). A master pin may then be entered (block **1304**) and the lock button pressed (block **1306**). For confirmation, the user may reenter the master pin (block **1308**) and then press the lock button (block **1310**). If this code matches (block **1312**), the user is notified that the master code has been set, such as with a long beep and/or flashing the keypad green (block **1314**). Otherwise, the user is notified that the master mode has not been enabled, such as with an audible beep and/or flashing the keypad red (block **1316**).

FIG. **26** shows example steps for disabling the master code option and removing the master code. In the example shown, the process starts by pressing the programming button **406** a certain number of times for a certain period of time (block **1400**) and then pressing the lock button a certain number of times (block **1402**). The system requires the master pin to be entered (block **1404**) and entered by pressing the lock button (block **1406**). Confirmation of the master pin is required (block **1408**) and by selecting the lock button (block **1410**). If the code matches (block **1412**), the user is notified that the master code option has been disabled, such as by a long beep and/or flashing the keypad a green color. Otherwise, the user is notified that the system was unable to disable the master code option, such as by an audible beep and/or flashing the keypad red (block **1416**).

Although the present disclosure has been described with reference to particular means, materials, and embodiments, from the foregoing description, one skilled in the art can easily ascertain the essential characteristics of the invention and various changes and modifications may be made to adapt the various uses and characteristics without departing from the spirit and scope of the invention.

What is claimed is:

1. An electronic deadbolt assembly comprising:

a latch assembly with a bolt movable between an extended position and a retracted position;

a motor operably connected to the latch assembly and configured to move the bolt between the extended position and the retracted position;

an exterior assembly including an electronic input device for entering a passcode, wherein the exterior assembly includes a wiring harness in electrical communication with the electronic input device;

an interior assembly including a circuit board with a controller configured to control actuation of the motor to move the bolt between the extended position and the retracted position responsive to receiving an authorized passcode from the electronic input device;

wherein the controller is in electrical communication with the electronic input device by an electrical connection between the wiring harness and an interior connector extending from the circuit board;

wherein the interior connector includes a first end connected to the circuit board with a wire and a second end extending from the circuit board and configured to connect with the wiring harness;

wherein the interior connector extends out of the interior assembly; and

wherein the interior connector is movable with respect to the circuit board about the wire;

wherein the interior assembly includes a back plate defining an opening through which the interior connector extends; and

wherein the circuit board includes a first side and an opposing second side,

wherein the interior connector is connected to a first side of the circuit board and extends from the second side through the opening in the back plate.

2. The electronic deadbolt assembly as recited in claim **1**, wherein the interior assembly includes a cavity defined between the back plate and the circuit board that is dimensioned to receive at least a portion of the wiring harness.

3. An electronic deadbolt assembly comprising:

a latch assembly with a bolt movable between an extended position and a retracted position;

an exterior assembly including an electronic input device for entering a passcode;

an interior assembly including a controller in electrical communication with the electronic input device using a wiring harness, wherein the controller is configured to

control movement of the bolt between the extended position and the retracted position responsive to receiving an authorized passcode from the electronic input device, wherein the interior assembly defines a longitudinal axis;

an interior cover housing the interior assembly;

a turnpiece extending through an opening of the interior cover;

a stem connected to both the turnpiece and an interior driver, the stem dimensioned to receive the turnpiece, wherein the interior driver is operably connected with the latch assembly; and

a mounting bracket including a plate portion defining a pass-through dimensioned to receive the wiring harness and a plurality of spaced-apart tabs extending transversely from the longitudinal axis of the interior assembly, wherein the interior assembly includes threaded openings correspondingly positioned with openings in the plurality of tabs for connecting the interior assembly to the mounting bracket, and wherein at least a portion of the tabs are spaced apart on opposing sides of the longitudinal axis of the interior assembly.

4. The electronic deadbolt assembly as recited in claim **3**, wherein the interior assembly further comprises a back plate and an interior cover dimensioned to receive the back plate.

5. The electronic deadbolt assembly as recited in claim **4**, wherein at least a portion of the plurality of tabs extend between the back plate and the interior cover.

6. The electronic deadbolt assembly as recited in claim **5**, wherein the interior cover includes a plurality of threaded openings alignable with the tabs in the mounting bracket.

7. The electronic deadbolt assembly as recited in claim **6**, wherein a portion of fasteners extend through the interior cover, tabs and back plate.

8. The electronic deadbolt assembly as recited in claim **3**, wherein the stem has a generally triangular shaped cross-section.

9. The electronic deadbolt assembly as recited in claim **3**, wherein the interior assembly includes a transmission with a gear train having more than two gears.

10. The electronic deadbolt assembly as recited in claim **9**, wherein the gear train includes three gears, wherein one of the three gears operably connected with the latch assembly.

11. An electronic deadbolt comprising:

a latch assembly including a bolt movable between an extended position and a retracted position;

an exterior assembly including an electronic input device configured to receive an input data, wherein the exterior assembly includes a wiring harness in electrical communication with the electronic input device;

a motor configured to move the bolt between the extended and retracted positions;

an interior assembly including a circuit board with a controller configured to control actuation of the motor responsive to input data received from the electronic input device, wherein the controller is switchable between:

a single user mode in which the controller actuates the motor responsive to an authenticated user code;

a master mode in which the controller actuates the motor responsive to an authenticated master code and an authenticated user code;

wherein in the master mode, the controller is configured to add an additional authenticated user code responsive to input data received from the electronic input device;

wherein the controller is in electrical communication with the electronic input device by an electrical connection between the wiring harness and an interior connector extending from the circuit board;

wherein the interior assembly includes a back plate defining an opening through which the interior connector extends; and

wherein the circuit board includes a first side and an opposing second side, wherein the interior connector is connected to a first side of the circuit board and extends from the second side through the opening in the back plate.

12. The electronic deadbolt as recited in claim **11**, wherein the controller is configured to switch between the master mode and the single user mode responsive to input data received from the electronic input device.

13. The electronic deadbolt as recited in claim **11**, wherein in the master mode, the controller is configured to delete an authenticated user code responsive to input data received from the electronic input device.

14. The electronic deadbolt as recited in claim **11**, wherein in the single user mode, the controller is configured to prohibit adding additional authenticated user codes.

15. The electronic deadbolt assembly as recited in claim **1**, wherein the interior connector is movable with respect to the wiring harness about the wire.

* * * * *